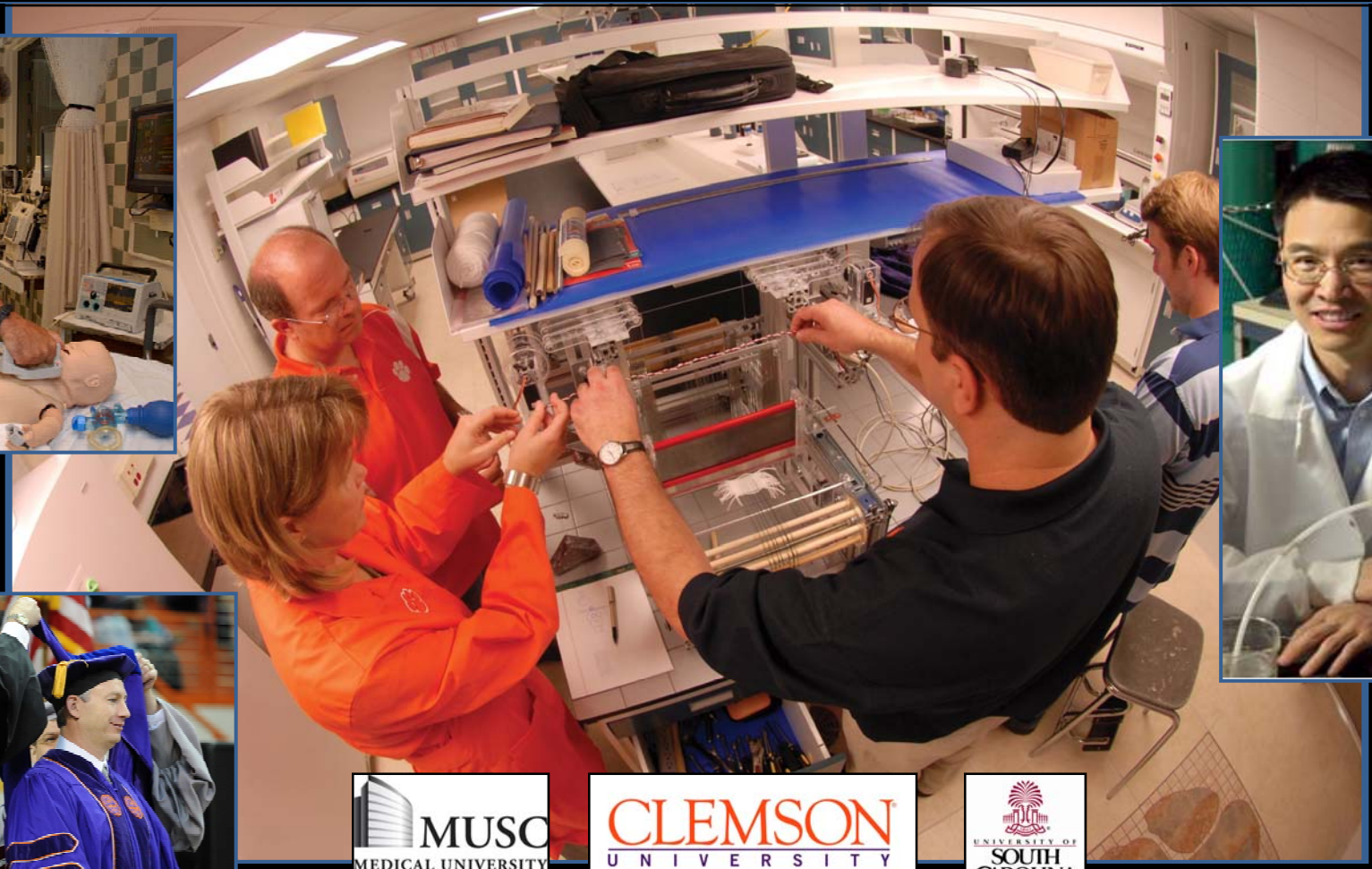
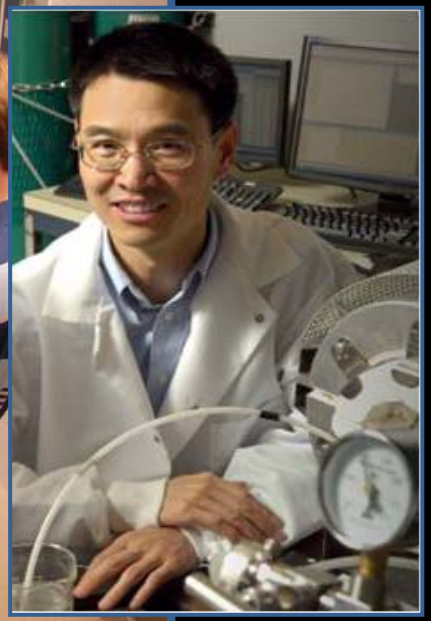
SOUTH CAROLINA

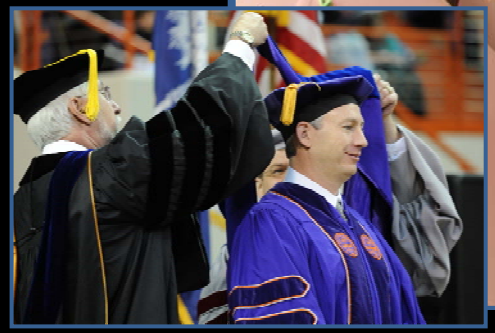
CEE

CENTERS of ECONOMIC EXCELLENCE

2009-2010 Annual Report to the S.C. General Assembly and the S.C. Budget & Control Board







MUSC
MEDICAL UNIVERSITY of SOUTH CAROLINA

CLEMSON UNIVERSITY

UNIVERSITY of SOUTH CAROLINA

FRONT COVER: (CENTER) CLEMSON UNIVERSITY TISSUE SYSTEMS CHARACTERIZATION COEE SENIOR PERSONNEL CONDUCTING RESEARCH ON A BENCHTOP LOOM; (TOP LEFT) MUSC COEE ENDOWED CHAIR DR. JOHN SCHAEFER OF THE CLINICAL EFFECTIVENESS AND PATIENT SAFETY COEE; (BOTTOM LEFT) CLEMSON UNIVERSITY INTERNATIONAL CENTER FOR AUTOMOTIVE RESEARCH GRADUATE STUDENT JOHN LIMROTH RECEIVES THE NATION'S FIRST AUTOMOTIVE ENGINEERING DOCTORATE; (RIGHT) DR. FRANK CHEN, USC ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING AND RESEARCHER FOR THE USC SOLID OXIDE FUEL CELLS COEE.

Message from the CoEE Review Board Chair

In just its eighth year, the Centers of Economic Excellence (CoEE) Program has doubled the General Assembly's original $180 million investment to boost research at our state's three research institutions. Through the CoEE Program, **more than $360 million in investment** from private and federal sources has entered the South Carolina economy—with hundreds of millions of dollars in additional investment announced.

The only thing more exciting than announcing a 2-to-1 return on the state's investment is announcing that the CoEE Program has resulted in **nearly 5,000 new jobs** being created through the 49 public-private partnership research centers known as Centers of Economic Excellence, or CoEEs. These are high-paying, knowledge-based economy jobs: **the average salary of a CoEE job is twice the average annual salary in South Carolina.**

The economic success of the CoEE Program reaches far and wide across our state:

In FY 2010, a number of new companies announced relocations to South Carolina, including automotive companies Sage, Proterra, and CT&T in the Upstate. Fuel cell company Trulite announced plans to relocate to Columbia to be near the innovative research of USC's Future Fuels™ Centers.

In FY 2010 alone, CoEE research team grants resulted in more than $50 million entering the state, and CoEE researchers were integral to MUSC receiving two additional $20 million federal biomedical research awards.

Major single partnership investments in CoEEs this past year include a $5 million commitment from global biomedical device manufacturer Smith & Nephew Biologics and Spine Division to fund research at the USC Rehabilitation and Reconstruction Science Center. And Clemson's Cyber-Institute CoEE received a $4 million partnership investment commitment.

The list goes on and on, proving that the CoEE Program is fulfilling its mandate to build the state's knowledge-based economy and create high-paying jobs and enhanced economic opportunities for the people of South Carolina.

Pamela P. Lackey
Chair, CoEE Review Board
December 2010

CoEE Review Board Chair Pamela Lackey,
pictured with (l to r) Clemson University President James Barker,
MUSC President Ray Greenberg, and USC President Harris Pastides.

SOUTH CAROLINA

CoEE

The CoEE Council of Chairs: Building South Carolina's Knowledge-Based Economy

A 2009 external review of the South Carolina Centers of Economic Excellence Program by the Washington Advisory Group produced the following recommendation:

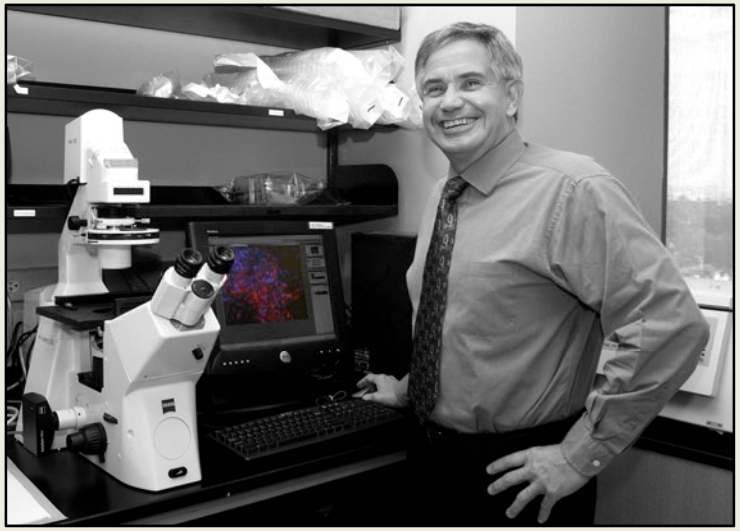
> "The CoEE Endowed Chairs are a 'brain trust' for South Carolina and should be called on to provide state leadership in matters of science and technology. To stimulate this activity, we recommend that the Program establish a 'Council of Chairs' that would meet at least annually."

In response to this recommendation, the CoEE Council of Chairs was established in October 2009. The mission of the CoEE Council of Chairs is to advise, coordinate, and provide leadership for South Carolina in matters related to science, technology, and knowledge-based economic development. The vision of the Council of Chairs is to be a scientific advisory board for South Carolina and a national model for using scientific leaders to provide advice to the state's legislature, universities, and industries.

The Council is committed to maximizing the benefits of the CoEE Program by coalescing statewide resources to develop a strong science base, support economic growth, and enhance the state's national and global image and competitiveness. This mission encompasses research, education, and technology transfer for a broad scope of applications including but not limited to biology and medicine, energy, environment, information technology, manufacturing, nanotechnology, tourism, and transportation.

Currently the Council of Chairs is planning a national conference for the CoEE Program for the fall 2011. This conference will enhance the state's visibility and image and establish South Carolina's leadership in developing a knowledge-based economy.

Dr. Richard Swaja
Chair, CoEE Council of Chairs
December 2010



Dr. Richard Swaja, MUSC CoEE Endowed Chair and FY 2010 Chair of the CoEE Council of Chairs, in his laboratory at the Regenerative Medicine CoEE.

The CoEE Program in the News
FY 2010

The Post and Courier
"Foundation Gives $20M to S.C. Universities to Research Organ Engineering"

The State
"USC Pulls in Record Funding for Research"

GSA Business
"Smith & Nephew to Invest $5M in USC Research at GHS"

SC BIZ
"South Carolina Named a Top Five Fuel Cell State"

Midlands Biz
"FirstString Research Achieves Successful Clinical Trial"

Automotive News
"South Carolina Center Offers Alternative for Auto R&D"

Charleston Regional Business Journal
"MUSC to Receive $20M grant from the National Institutes

The Post and Courier

In 2002, the General Assembly passed the Research Centers of Economic Excellence (RCEE) Act. Since 2003, $180M has been appropriated from the State Education Lottery to establish unique Centers of Economic Excellence (CoEEs) at SC's three research institutions: Clemson, USC, and MUSC.

The RCEE Act created the CoEE Review Board, which provides program oversight. Staff and operational support are provided by the Commission on Higher Education, which approves the program's operational budget.

The CoEE Review Board oversees an annual competitive process whereby CoEEs and supporting CoEE Endowed Chairs are proposed by the research institutions. Once a CoEE is awarded, an institution has 18 months to acquire $1:$1 matching pledges from non-state sources equal to the state award ($2M-$5M). Pledges must be "realized" (in hand) within six-and-a-half years of the award date. The entire state award plus a portion of the $1:$1 match is placed into permanent endowment; the endowment provides funding for CoEE research equipment, lab construction, and research team salaries.

The Review Board has awarded 49 CoEEs and 87 CoEE Chair positions. Each Center specializes in knowledge-based research fields such as environmental science, engineering, nanotechnology, biomedicine, cancer research, and energy science. The CoEE Endowed Chairs secure private sector and federal grants to increase the state knowledge base and stimulate the economy.

CU-ICAR CoEE Endowed Chairs Thomas Kurfess (l) and John Ziegert (r) discuss the knowledge-based economy with S.C. Representative Gilda Cobb-Hunter.

Former Queensland (AU) Premier the Honorable Dr. Peter D. Beattie (center) discusses the Smart State Initiative with the CoEE Review Board.

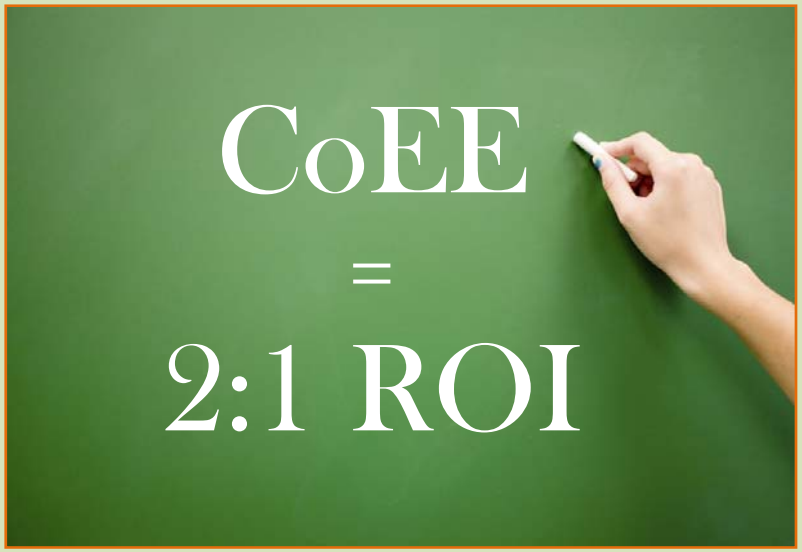
SOUTH CAROLINA CoEE

State Investment
$180 million

External Investment
$363 Million

Question:

Is the CoEE Program fulfilling its mandate to build the knowledge-based economy in South Carolina?



Answer: YES!

For every $1 SC government has invested in academic research . . .

the private sector and non-state sources have invested $2!

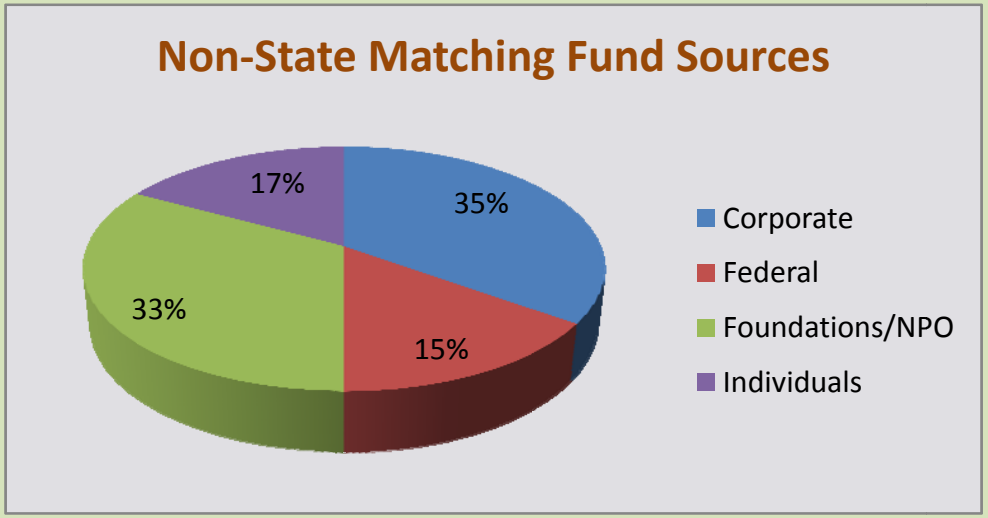
Q: What are the sources of the $363M in external investment in the CoEE Program?

ANSWER:

NON-STATE MATCHING FUNDS: $158 MILLION

By statute, state dollars must be matched on $1:$1 basis with investment from non-state sources such as corporations, non-profit organizations, private investors, and the federal government.

Some people have suggested that the CoEE Program uses mostly federal dollars to meet its $1:$1 matching requirement. However, federal matches account for only 15% of total matching funds. **Corporate and organizational investments account for 2/3 of all matching funds.** And corporate and organizational donations **above $500K** account for **$50M** of the $158M total.



EXTRAMURAL RESEARCH GRANTS: $205 MILLION

The CoEE Endowed Chairs and their research teams receive corporate and federal grants to conduct their innovative research. In FY2010 alone, more than $50M in CoEE research team grants entered the SC economy. And more than $10M has entered the state by CoEE Endowed Chairs transferring research grants upon their appointment to a SC institution.

CoEE Economic Impact:
Return on Investment

Question:

Is the CoEE Program fulfilling its mandate to create high-paying jobs in South Carolina?

Answer: YES again!

The CoEE Program has created more than 4,700 new jobs in South Carolina!

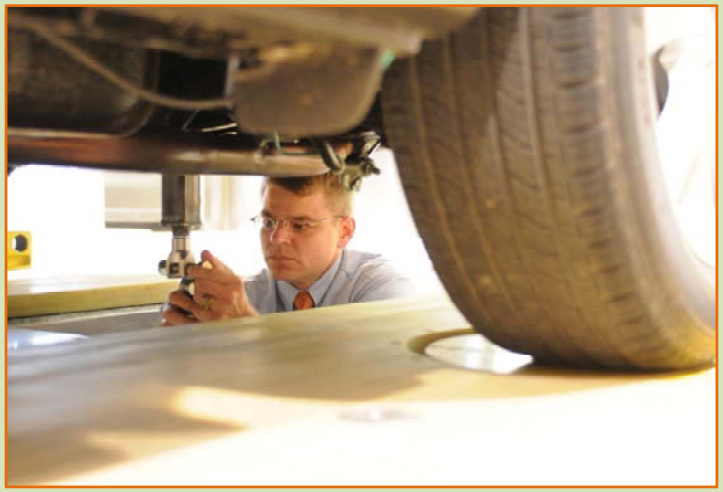
One of the principal mandates of the CoEE Program is the creation of high-paying jobs in South Carolina. To date, the CoEE Program has created **4,717 high-paying, knowledge-based economy jobs**. This figure includes 1,495 CoEE personnel, start-up company employees, and corporate relocation personnel. According to the USC Darla Moore School of Business, an additional 3,222 new jobs have likely resulted from the impact of $205 million in extramural research funding brought into the South Carolina economy by CoEE Endowed Chairs and their research teams.

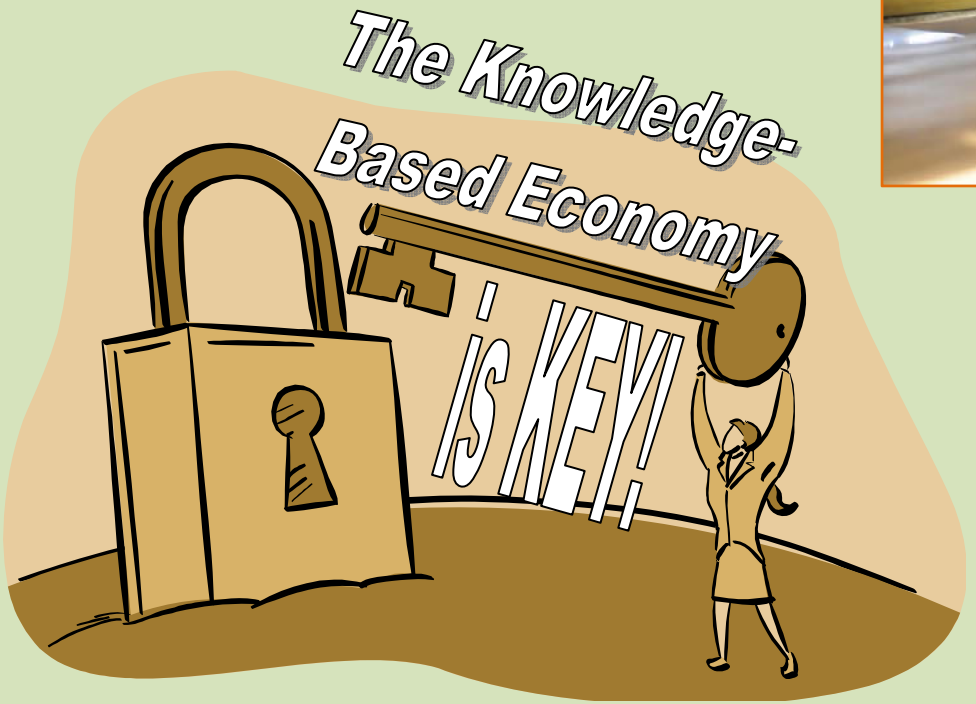
CoEE Economic Impact: High-Paying Jobs

QUESTION: Are these 4,700 CoEE jobs really high-paying?

ANSWER: The average salary of a CoEE job is $63,000!*

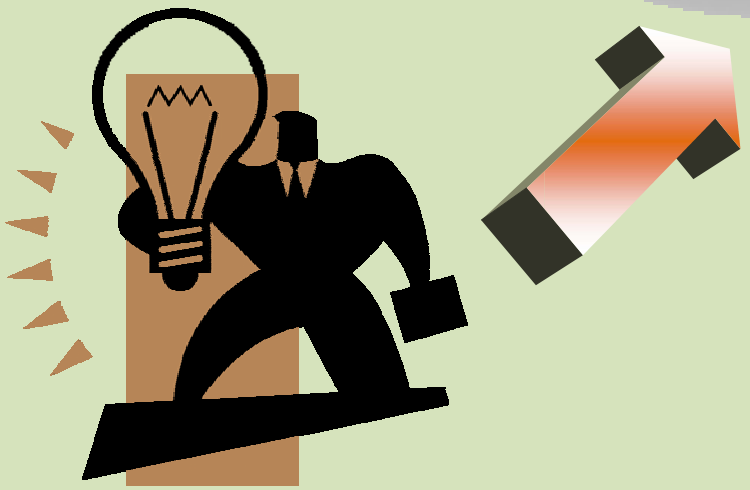
That's nearly twice the average SC annual salary!





* Data reflects reported salaries of 530 CoEE jobs.

SOUTH CAROLINA CoEE
CENTERS of ECONOMIC EXCELLENCE
RESEARCH • INNOVATION • INVESTMENT



QUESTION:

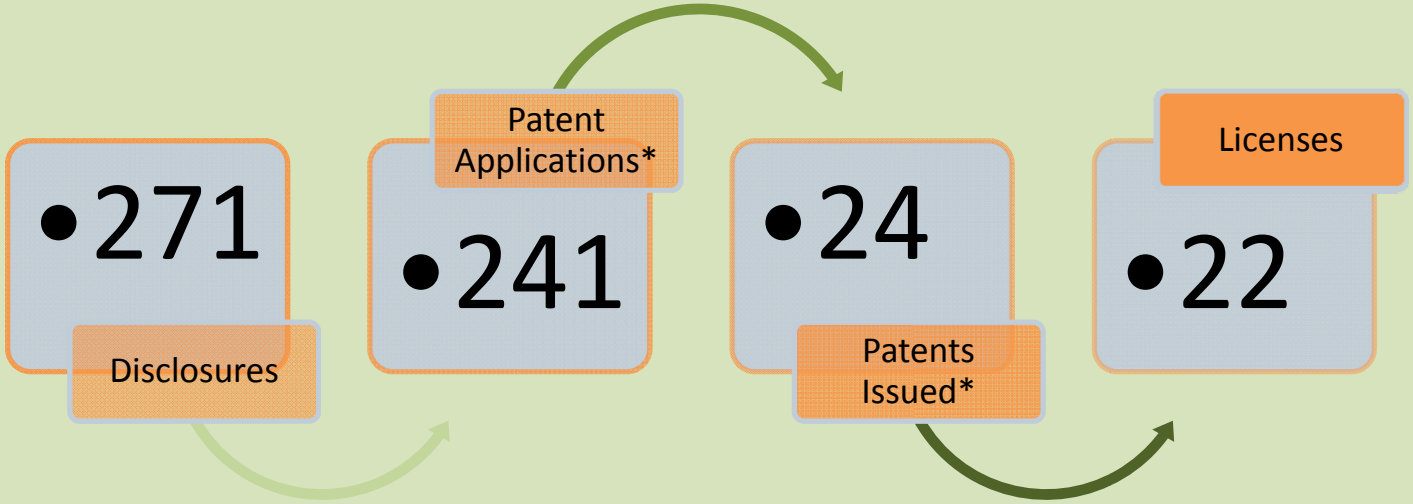
What is Technology Transfer?

ANSWER:

TECHNOLOGY TRANSFER is the process of converting scientific discoveries into marketable products. When a CoEE researcher makes a scientific **DISCOVERY** that has commercial possibilities, his or her institution files for a **PATENT**—a set of exclusive rights granted by the U.S. government to an inventor (or assignee) for a certain period of time. USC, MUSC, and Clemson have individual technology transfer offices to handle the patent process of scientific discoveries (also called "intellectual property").

A patent allows an invention owner to bring a product to market exclusively. Often with high-tech products, this "exclusivity" provides enough financial return to justify the investment required to place a product on the market. In addition to U.S. patents, institutions seek international patents that secure invention rights abroad.

CoEE Program Technology Transfer Statistics



* Includes U.S. and International.

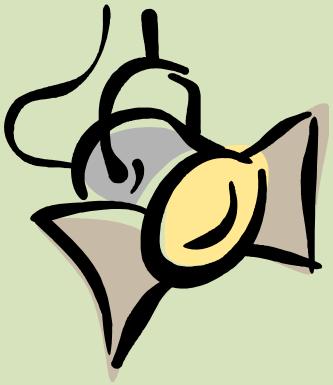
With a **LICENSE**, a university grants the right to practice the patentable invention to a commercial entity, which then invests the resources required to place a product on the market. There are typically two ways that technology transfer leads to economic development:

Sometimes the entity which purchases a license starts a new company based on the newly developed product or service. This commercial enterprise is called a **STARTUP COMPANY**.

Other times, an existing company will license the intellectual property and produce the new product or service, which leads to a robust relationship with the university and region.

Selling licenses for the use of intellectual property can be lucrative for universities. The licensure of inventions such as Gatorade and Taxol has netted Florida public institutions of higher education hundreds of millions of dollars in the past decade.

While the CoEE Program is relatively young in terms of intellectual property generation, USC, MUSC, and Clemson have received more than $800,000 in license income to date.



CoEE Startup Company Spotlight: SimTunes celebrates major success!

Medical simulation is a training method that allows health care professionals to practice treating specific conditions on sophisticated mannequins that simulate real-world emergencies. South Carolina is home to one of the world's leading experts in this field, MUSC CoEE Endowed Chair Dr. John Schaefer of the Clinical Effectiveness and Patient Safety CoEE.

Schaefer develops educational products and technology used in simulation training for doctors, nurses, and other medical professionals. In 2008, Schaefer and businessman Heyward Coleman started a company, SimTunes, to commercialize these developments. That same year, the company received a $50,000 grant from SC Launch.

In 2010, SimTunes successfully sublicensed its educational products and technology to Laerdal Medical, a Norway-based medical simulation products company that will distribute SimTunes' products worldwide.

Coleman, who has three decades of experience starting and developing businesses, believes SimTunes has very good prospects for long-term success: "This is a new field with a market that is almost certain to grow rapidly."

CoEE Endowed Chair Dr. John Schaefer (l) conducting a medical simulator demonstration with CoEE Review Board member Melvin Williams (r).

The mannequins and other equipment used in simulation training are designed to create as realistic a setting as possible. "The mannequins can bleed, breathe, have irregular situations," says Coleman. "You walk into a room and it looks like an operating room. But the mannequins are only as good as the scenarios."

The potential benefits of these realistic simulation settings for health care consumers are enormous, as health care professionals can gain experience and hone their skills in true-to-life situations without putting actual patients at risk.

"Right now the simulation field seems to be growing faster from the point of view of making gadgets," Coleman adds. "There is a lot of hardware, but something needs to run the hardware. The idea of the formal distribution of scenarios and related educational material is somewhat lagging. It's going to become a big field."

CoEE Economic Impact: Startups & Relocations

CoEE Startup Companies

Advanced Photonic Crystals
FirstString Research
Hydrogen Hybrid Mobility
ImmoMod, Inc.
MitoHealth, Inc.
Palmetto Fuel Cell Technologies, LLC
MicroVide
NextGenEn, Inc.
Parallel Permeation, Inc.
SchnellGen, Inc.
SemiAlloGen, Inc.
SimTunes, LLC
Specialty Custom Fibers
Tetramer Technologies
Vortex Biotechnology

CoEE Corporate Relocations

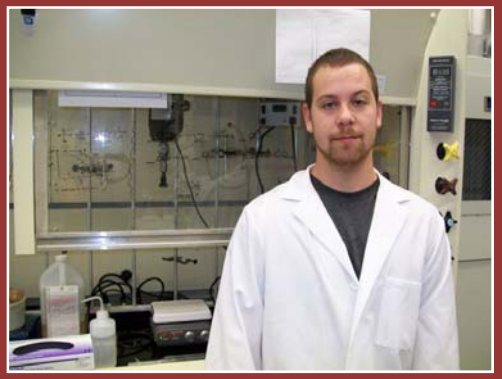
- American Titanium Works
- BMW ITRC
- CADFEM U.S.
- Cephos
- CT&T
- Greenway Energy
- Gulf Fiber Optics
- Intec U.S. Inc.
- JTEKT TC
- Proterra
- Sage Motors
- Trulite

SimTunes Success [continued...]

Among the educational simulation scenarios on the market, SimTunes scenarios differentiate themselves by including a detailed evaluation component that allows instructors to objectively grade a student's performance once the scenario is completed, something that other existing simulation scenarios lack.

"We are developing some of the best scenarios that are out there," Coleman says. "Dr. Schaefer has many years of experience developing these scenarios. He is one of the nation's leaders."

A health care professional receives CoEE medical simulation training.



USC doctoral student
Alex Gulledge

CREATING A FUTURE:
Polymer Nanocomposites CoEE Provides Career Direction

USC CoEE Endowed Chair
Brian Benicewicz

Columbia native Alex Gulledge had the usual plans as his graduation from USC approached. He would just "find a job somewhere." After all, his chosen field, chemistry, offered a myriad of industrial opportunities.

Along the way toward earning his undergraduate degree, he discovered a passion he had not anticipated and one that rekindled the work ethic and self-motivation he learned from his hardworking father: **scientific research.** Gulledge is now embarking on a new path toward a Ph.D. and exciting career choices in South Carolina.

Gulledge is one of thousands of students impacted by the CoEE Program, and he is a perfect example of the program's major goal to create high-paying jobs in South Carolina and retain the state's best and brightest students.

In his junior year, Gulledge became involved in a research group with Dr. Brian Benicewicz, the CoEE Endowed Chair in Polymer Nanocomposite Research at USC's NanoCenter and Chemistry and Biochemistry department.

Gulledge says the opportunity changed his life, "It gave me motivation. During my freshman and sophomore years, my goal was to get a degree and a job. I was introduced to the idea of graduate school once I began working with graduate students in Dr. Benicewicz's lab. Experienced graduate students helped me determine to continue my studies. And having my own independent research work made me realize how much I love research."

Benicewicz saw Gulledge's excitement the minute he stepped into the laboratory. "Research always motivates undergraduates. When Alex entered the research lab, he finally realized what chemistry was all about—not just reading books and taking exams."

Research at the POLYMER NANOCOMPOSITES COEE focuses on developing improved materials for the polymers market. The plastics industry accounts for 5% of South Carolina Gross State Product of goods and services. This CoEE aims to transform the state's plastics industry and manufacturing economy.

USC graduate student Alex Gulledge:

"When I was considering where to work on my Ph.D., no other school...had the opportunities that are available here at USC."

Benicewicz's research in high-temperature fuel cell membranes has resulted in a research contract with BASF, the largest chemical company in the world. BASF has developed fuel cell units being used in U.S. and European homes and portable power devices. Benicewicz has designed new materials for electronics, optical, and other industrial applications.

Seeing the real-world applications of his research is part of what excites Gulledge. "The potential for commercial development is abundant. The hands-on experience I am receiving at USC will allow me to excel and provide opportunities once I move into industry."

Working in Benicewicz's CoEE lab made all the difference in the world to Gulledge, even positively impacting his grades. "In my first two years, I had a GPA of 2.5, but in my junior and senior years, it improved beyond 3.5. My grades were up because my focus was up."

"If I had not been exposed to research as an undergraduate, I would not have gone on to graduate school," Gulledge says. "When I was considering where to work on my Ph.D., no other school I investigated had the opportunities that are available right here at USC."

Benicewicz notes that competition for good doctoral candidates is fierce; the CoEE Program allows USC to remain competitive. "These candidates see that research exists elsewhere. But it's better here, so why not stay?"

Gulledge adds, "The CoEE Program attracted Dr. Benicewicz here. Without this, I would not have the opportunities I have now."

Benicewicz believes the CoEE Program is doing what it was intended to do: create jobs and have a positive economic impact in South Carolina. "Our students are getting jobs in research. They're going into industry. They're making products. They're making their own opportunities."

Efficient and Effective: Clemson Degree Prepares Next Generation of Industry Leaders

For decades, retailing and manufacturing giants have improved their supply chains—and their bottom lines—using industrial engineering techniques to become more efficient and effective.

Clemson University now offers a master's degree in industrial engineering with a concentration in capital projects supply chain and logistics. The program is specifically designed for working professionals and is a partnership between the Supply Chain Logistics and Optimization CoEE and Fluor, a Fortune 500 engineering and project management company.

"The blueprint is simply to follow the lead of others, such as Wal-Mart and Toyota," says Dr. William Ferrell, Clemson professor of industrial engineering. "Improve execution of capital projects by adapting industrial engineering techniques on this supply chain. The master of engineering is a linchpin to achieving this because students use their knowledge to help their employers—owners, contractors and subcontractors/suppliers—make improvements that yield stronger financial performance and improve competitive position."

The program draws students from a diverse array of firms including Boeing, CH2MHill, Foster Wheeler, Hatch Engineering, and UPS. Classes are offered online through asynchronous, web-based delivery with no residency requirements. Lectures can be downloaded to a desktop or laptop, iPod, or other mobile device. Since courses are self-paced and web-accessible, students can continue their educations regardless of location or schedule.

"The success of this degree program is in its overall design," says Fluor Power Group 2008 cohort Trey Wills, executive director of operations in the company's Charlotte office. "Flexible for full-time professionals; taking advantage of familiar technology interfaces, such as the Internet, and the program's focus on our engineering, procurement, and construction, EPC, way of doing business."

The program's multidisciplinary approach integrates tools from industrial engineering, civil engineering, and management. The structure provides a diversified knowledge base for improving supply chain processes today and durable tools and concepts that will continue to serve the graduate in facing the challenges of tomorrow.

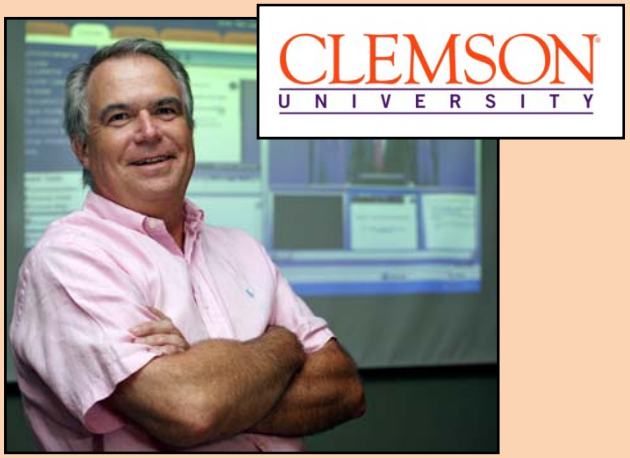
Ferrell says the program provides industry with the ability to stay competitive, to gain market share and to preserve jobs. In addition, it helps meet the demand for high-quality education delivered asynchronously. "Many working professionals have a strong desire to obtain a first-class graduate degree but cannot enroll in traditional campus programs. This degree is targeted to them."

Ferrell adds that the program also increases the number of industrial engineers with graduate degrees, which benefits the state tremendously. "History indicates clearly that increasing the knowledge base will allow companies to become more competitive."

Program graduates emerge with specialized knowledge in capital projects supply chain not available elsewhere. Ferrell explains, "The EPC industries in the state find our graduates' skills particularly attractive. A master's degree in industrial engineering allows students to compete for jobs in industries like production, manufacturing, distribution, electric utility, tourism, finance, and health care."

The program began in 2008 and has grown to 100 students. The first class graduates at the end of 2011.

Ferrell says, "Our students become project managers, workers in all aspects of procurement, piping engineering, and structural engineering. We also have people who work in distribution for UPS, Alstom, and Panalpina; production for Boeing; and finance for BMW."

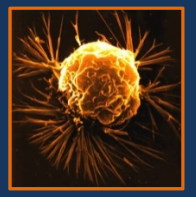


Bill Ferrell, a professor in the Clemson Department of Industrial Engineering and a leading researcher in the Supply Chain Optimization and Logistics CoEE.

Students in the program see its value. Erin King, a 2009 Fluor Power Group cohort and procurement specialist in its Charlotte office, says, "Since starting the Clemson program, I have a new job perspective. I see opportunities for improved efficiencies, implementation of new tools, and a growing appreciation for managing variability."

"In our business, supply chain represents over 50% of project costs," adds Ajay Joshi, also a 2009 Fluor Power Group cohort and project engineer in Charlotte. "It makes sense to learn to manage our supply chain before we manage projects."

New hope for cancer patients:
The CoEE Program Brings Lifesaving Clinical Trials to SC



For patients battling cancer, access to the latest drug therapy can mean the difference between remission and disease—and ultimately life and death. That has certainly been true for Bobby Potter who lives near Summerville. Every morning when he wakes up, he is thankful for a day he was not supposed to have.

"My time was supposed to be up in June 2009," Potter recounts.

Potters' days have been extended by the opportunity to participate in a national, multicenter clinical trial led by the Medical University of South Carolina's Hollings Cancer Center (HCC). The study is combining innovative drugs to treat patients who have advanced hepatocellular carcinomas, or cancer originating in the liver. The drugs are targeted at the unique biology of cancer cells and therefore spare patients many of the severe side effects commonly associated with traditional chemotherapy.

CoEE Endowed Chair Dr. Melanie Thomas with Summerville resident and cancer survivor Bobby Potter.

Potter, a 57 year-old former landscaper and auto glass installer calls it "the clinical trial that saved my life."

Potter's cancer was diagnosed by a gastroenterologist/hepatologist at MUSC who had been treating him for another condition. Routine scans revealed that Potter had advanced liver cancer. Without treatment, he had less than one year to live.

Potter, the father of a nine-year-old son, decided to fight. He was referred to Dr. Melanie Thomas, one of the nation's top oncologists and the Grace E. DeWolf CoEE Endowed Chair in Medical Oncology.

Thomas, formerly of the M.D. Anderson Cancer Center (Texas), has devoted her career to Gastrointestinal (GI) cancers, which are among the toughest to treat. Currently, she is leading the national liver cancer trial at HCC.

Cancer survivor Bobby Potter:

"I've gone from being in a pit to coming back and seeing daylight. Everything is new again."

Potter recalls, "Dr. Thomas told me I could do the regular treatment or get into the trial. I wanted to try something which would give me longer to live."

Thomas leads the GI CANCER DIAGNOSTICS COEE. GI malignancies or cancers include those of the stomach, liver, pancreas, colon, and elsewhere in the GI tract. Research at this Center includes searching for new targets (proteins that play a role in the disease process and are the intended sites of drug activity) for GI cancer treatment and identifying new ways to screen for GI cancer.

Thomas also serves as associate director of clinical investigations at HCC, where she is spearheading an effort to increase patient participation in clinical trials and expand South Carolina clinical drug trials.

Thomas notes that in the past, many patients needed to travel outside the state to participate in clinical trials. Today, through the efforts of the CoEE Program and doctors and staff at HCC, more patients like Potter are gaining access to high-quality clinical trials in the Palmetto State. Thomas also believes that bringing clinical trials to South Carolina will attract pharmaceutical companies, which would drive the economy and create high-paying jobs.

"Right now, South Carolina may not be on their radar screens," Thomas says. "But when they realize that we have a clinical trials network and that they can put patients on studies at multiple locations around the state, they are more likely to open clinical trials here."

A few months after Potter joined the liver cancer clinical trials, his 17 cm. tumor had shrunk by two-thirds. Today, scans reveal that it is barely visible. Thomas calls Potter's progress "thrilling."

Potter sees himself as cancer-free and is moving forward with his life. He has bought land and has planted a garden. Although he'll do chemotherapy for a year, he sees every day as a new, exciting milestone.
"I've gone from being in a pit to coming back and seeing daylight," he says. "Everything is new again."

SOUTH CAROLINA CoEE

The Potential for Tourism Growth in SC: An interview with CoEE Endowed Chair Dr. Simon Hudson

Dr. Simon Hudson, USC CoEE Endowed Chair.

In 2010, USC successfully recruited Dr. Simon Hudson as the CoEE Endowed Chair in Tourism and Economic Development to lead the Tourism and Economic Development CoEE.

Hudson and his research team are helping South Carolina capture a greater share of the tourism market, so that the industry can drive economic growth and create jobs. Although tourism already employs around 200,000 South Carolinians, Hudson believes the industry has tremendous potential for growth.

How can tourism drive the state's economy and create jobs?

Hudson: Over the previous two decades, South Carolina has experienced a surge in jobs and people and demonstrated a capacity to remake the economy. Greenville-Spartanburg is a good example, shifting from a cotton mill economy to becoming one of the South's largest automotive centers and a hot spot for foreign investment. However, globalization and technological change have adversely affected our state; we are no longer as attractive to industries seeking cheap land and plentiful low-cost, low-skill labor. As a consequence, unemployment has remained high in the state. Twelve South Carolina counties fit the definition of persistent poverty.

The tourism industry offers tremendous potential for job creation. Tourism is the state's number one industry, responsible for more than $18 billion in spending and employing ten percent of the state's workforce. Tourism is by nature labor-intensive, so by developing tourism, we increase employment. Tourism can also have a positive impact on other sectors of the economy—hospitality, retail, transportation, the golf industry, even real estate.

Tourists may also become residents. Research shows that about 2 million people visit South Carolina annually with the primary purpose of investigating second homes, relocation, retirement, new jobs, and business opportunities.

The tourism industry generates $18.4 billion in total annual economic demand in South Carolina.

Source: The U.S. Travel Association

What is the potential of tourism in the state, and how is the state reaching its potential?

Hudson: The U.N. predicts international tourism will grow more than four percent per year through 2020. International tourism arrivals are expected to grow to 1.56 billion by 2020, with long-haul travel growing faster than interregional travel. There is no reason South Carolina cannot be part of this growth.

But we must be more competitive. A few years ago a consultant from Ireland came to South Carolina to analyze the tourism industry and called South Carolina "a flower waiting to bloom." We have excellent natural resources—not just incredible beaches, but beautiful mountains and lakes. Other destinations can boast such resources, but they don't have South Carolina's hospitality. They also don't have the culture and history. And they certainly don't have more golf courses per capita than any other state!

Research suggests that levels of awareness about South Carolina are low nationally and internationally. We need to shout more about what we have. Tourism is our number one industry, so it will play a critical role in getting the economy back on track. We need to invest more in branding and promotion.

We spend less on marketing than our competitors. Return on investment for tourism promotion can be very high: for every dollar spent, you can expect an average return of $10 in tourism expenditures.

We also need more research. That is where the CoEE Program can help.

What are some ways your CoEE is working to increase and improve tourism in SC?

Hudson: The Center will lead cutting-edge tourism and hospitality research that is relevant and directly applicable to the state tourism industry. I have identified a number of research areas, including medical and health tourism; sustainable and pro-poor tourism in rural areas; golf tourism, particularly in the international market; film tourism; as well as research related to building the SC brand.

A new USC Ph.D. program will attract high-quality students who will undertake research to improve state competitiveness as a tourism destination. The research we do will be disseminated widely.

I would like the CoEE to become a one-stop resource of relevant information and intelligence to all South Carolina tourism stakeholders.

CU-ICAR's Grand Slam Success Story: An Interview with Bob Geolas

Bob Geolas, Executive Director of CU-ICAR.

CU-ICAR is home to four CoEE Endowed Chairs, who have been instrumental in attracting major corporate investment and helping CU-ICAR become a South Carolina jobs engine. In addition, these world-class professors are helping CU-ICAR fulfill its vision of becoming the world's premier automotive and motorsports research and education facility.

CU-ICAR has attracted more than $220 million in public/private investment including major corporate partnerships with BMW, Michelin, and KOYO. Other companies have also recognized the wisdom of being in close proximity to CU-ICAR. American Titanium Works is building a world-class titanium mini-mill in Laurens County; this relocation will result in 360 new jobs and $422 million in state investment. And electric bus manufacturer Proterra has announced it will build a $68 million, 1,000-job plant in Greenville.


The CU-ICAR Carroll A. Campbell Jr. Graduate Engineering Center.

The CU-ICAR CoEE Endowed Chairs lead a unique graduate program, including the nation's first Ph.D. in automotive engineering. The program graduated its first class in 2009 and includes students from across the globe.

CU-ICAR Executive Director Bob Geolas shares how the CoEE Program has been instrumental to the success of the research campus and provides a glimpse of what the future may hold.

CU-ICAR has been tremendously successful in attracting private investment to the state. Discuss some of these successes and the jobs that have been created.

Geolas: Early investment from BMW and Michelin propelled the project. The establishment of onsite R&D centers for BMW and Timken (now KOYO) gave us early market credibility. Today, we have dozens of new partnerships. With recent announcements from American Titanium Works, Proterra, and Sage, CU-ICAR has played a role in creating 2,000 jobs in South Carolina.

How have the four automotive-related CoEE Endowed Chairs helped CU-ICAR?

Geolas: We could not do what we have done without the CoEE Program. The attraction for any private investment is the proximity to talent—research and workforce.

How are the four CoEE Endowed Chairs (Hubing, Kurfess, Ziegert, Venhovens) helping CU-ICAR fulfill its mission?

Geolas: The CoEE Endowed Chairs bring a level of international recognition and credibility that is critical when being globally competitive. Their talent as individuals and their influence with industry and government have been instrumental to CU-ICAR's success.

The CoEE Program has enabled CU-ICAR to create leading-edge graduate programs. How are these degree programs benefitting CU-ICAR and the state economy?

Geolas: The graduate programs recruit talent and bring industry interested in a strong workforce. Ideally, these talented people stay and strengthen the knowledge base and the economy.

Why has CU-ICAR been so successful?

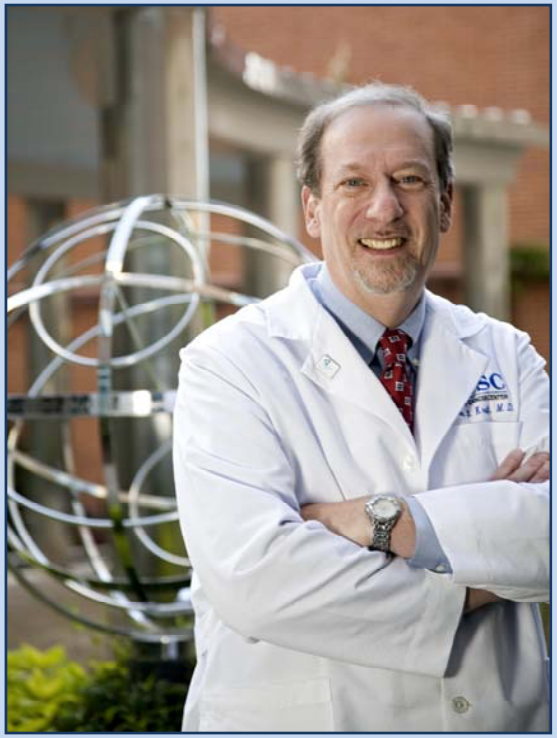
Geolas: A bold vision, strong leadership and hard work have marked our success—three elements that really describe the Clemson way of doing business.

What do you see for CU-ICAR in the future?

Geolas: First, we need to complete the projects underway—including our new Center for Emerging Technologies, the campus' first multi-tenant building. After that, we need to continue to build this strong foundation. We do not see any reason to pull back. The future is very promising.

CoEE and the Fight to Cure Cancer: An Interview with Dr. Andrew Kraft, MUSC Hollings Cancer Center Director

Under the direction of Dr. Andrew Kraft, the MUSC Hollings Cancer Center (HCC) is working to become the state's best resource—and one of the nation's best centers—for developing new knowledge about cancer and translating that knowledge into effective prevention and treatment.



Dr. Andrew Kraft, director of the MUSC Hollings Cancer Center.

In 2009, the HCC was designated a National Cancer Center by the National Cancer Institute in recognition of the center's research strength. Today, HCC is one of only 66 NCI-designated cancer centers in the nation.

Helping to drive the center's cutting-edge research are several cancer-related Centers of Economic Excellence and CoEE Endowed Chairs. Through the CoEE Program, HCC has been able to recruit renowned scientists, dramatically increase research funding, and launch a statewide clinical trials network.

Dr. Kraft shares the ways in which the HCC-based Centers of Economic Excellence are helping save and improve the lives of cancer patients in South Carolina and beyond.

MUSC CoEE Endowed Chair cancer research superstars (l to r) John Lemasters, Zihai Li, George Simon, Charles Smith, Kenneth Tew, and Melanie Thomas.

Please share some of the research highlights of the cancer-related CoEEs.

Kraft: There are exciting things happening in the CoEEs related to the Hollings Cancer Center [HCC]. First, I want to mention Dr. Melanie Thomas, who leads the GASTROINTESTINAL CANCER DIAGNOSTICS COEE. She is an oncologist and associate director of clinical investigations at HCC and is leading a national, multicenter clinical trial for people with liver cancer.

Also, Dr. Charles Smith, who leads the CANCER DRUG DISCOVERY COEE, is working to design drugs to fight cancer by unlocking the molecular mechanisms important for tumor growth. His research could enable the development of drugs to fight a variety of inflammatory diseases, including arthritis and Crohn's Disease. Working with other researchers, Smith has identified a target in cancer cells which could be integral to the growth of our state's life sciences industry.

The CoEE Program has helped HCC recruit some world-class researchers as CoEE Endowed Chairs. Please tell us how they are helping to save and improve patient lives.

Kraft: In my opinion, the hallmark of the CoEE Program is that it allows us to recruit great talent from all over the U.S. In terms of medicine, these people will stimulate others to make important discoveries that will change the health outlook for our citizens as well as spur the economy.

In 2009, the MUSC Hollings Cancer Center was designated a National Cancer Center by the National Cancer Institute. Several CoEE Chairs were critical in earning this distinction.

How is the CoEE Program helping HCC expand clinical trials in South Carolina?

Kraft: The CoEE Program has taken a considerable step forward relative to cancer clinical trials. CoEE Chairs Drs. Smith and Thomas have submitted an NIH grant proposal which, if funded, will support early phase testing of a cancer fighting agent identified by Dr. Smith.

Dr. Thomas also has a multi-center, investigator-initiated Phase II liver cancer trial that has as a goal enrolling 120 patients from six U.S. centers.

SOUTH CAROLINA CoEE

CLEMSON UNIVERSITY

13 CoEEs
16 CoEE Chairs

UNIVERSITY OF SOUTH CAROLINA

17 CoEEs
29 CoEE Chairs

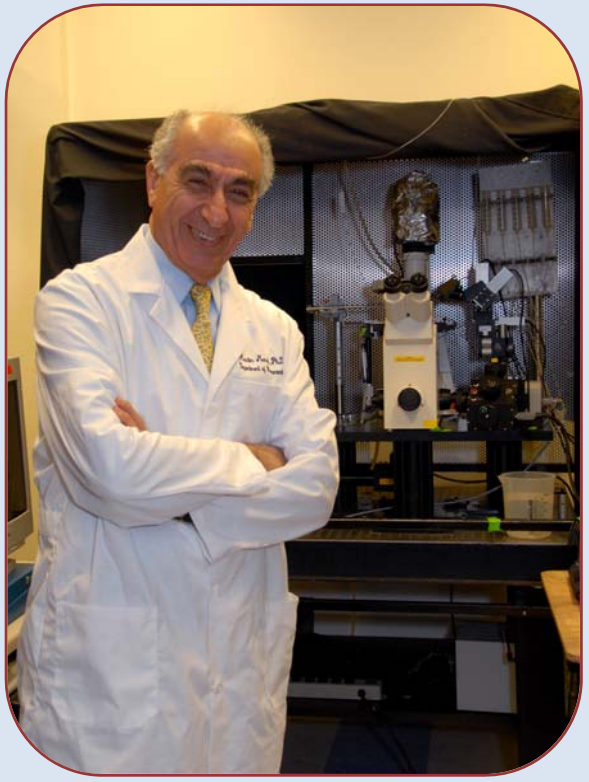
MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA

19 CoEEs
42 CoEE Chairs

CU-ICAR CoEE Endowed Chair Paul Venhovens teaching graduate students.

USC Discovery research facility.

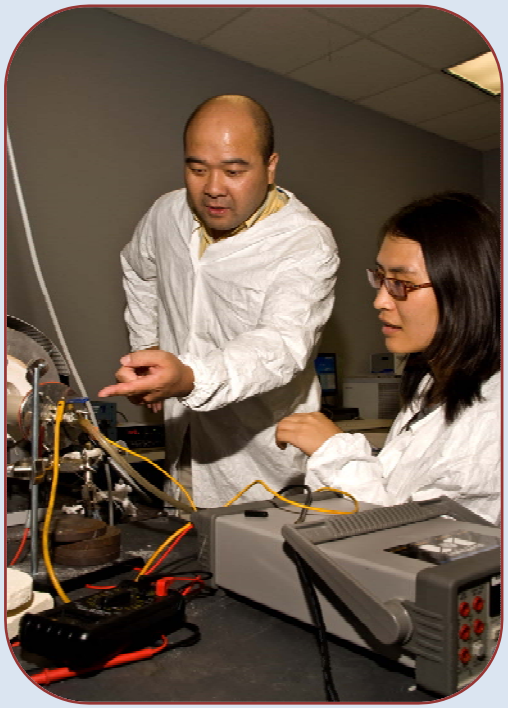
MUSC Clinical Effectiveness & Patient Safety CoEE ICU Simulation Control Room.



USC CoEE Chair Dr. Martin Morad uses a Zeiss Axiovert 135 microscope for simultaneous calcium imaging and electrophysiological studies in single live heart cells.

Center Summaries

MUSC CoEE researchers Dr. Spinale (standing) and Dr. Zile (seated) work with patients like Mrs. Anne Patrick to develop novel biomarkers that will improve diagnosis and treatment of patients with diastolic heart failure.



USC CoEE researcher Dr. Chris Xue explains measurement parameters to Ph.D. student Xinfang Jin in the Solid Oxide Fuel Cell CoEE laboratory.

(l to r) Clemson President Jim Barker and Dean of Engineering Dr. Esin Gulari thank Vernon Williams, CEO of PalmettoNet and Bryant G. Barnes, president and CEO of Comporium, for their companies' investment in the Optoelectronics CoEE.

Dr. Jay Moskowitz, USC CoEE Endowed Chair and Health Sciences South Carolina President, discusses the CoEE Program with S.C. Senator Ralph Anderson.

SOUTH CAROLINA CoEE
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RESEARCH • INNOVATION • INVESTMENT

AUTOMOTIVE AND TRANSPORTATION TECHNOLOGY

[SEE ARTICLE ON PAGE 17.]

CLEMSON UNIVERSITY

5 CENTERS
5 CoEE CHAIRS

CU-ICAR CoEE Endowed Chair Dr. Todd Hubing directs research for the Vehicle Electronic Systems Integration CoEE.

Automotive Manufacturing

Award Date: 2003 **Award Amount:** $5 million **Institution:** Clemson

BMW CoEE Endowed Chair in Automotive Manufacturing: Dr. Thomas Kurfess

This CU-ICAR CoEE is developing novel micro-electromechanical systems technologies for manufacturing and improving the efficiency of manufacturing large, complex objects.

Scientific discoveries include the development of an apparatus that simulates the effects of contaminants, soil, and lubrication on rotating machinery such as gears, wheels, and fan blades. In FY2010, this CoEE began working with American Titanium Works to build a team to study up-armored civilian vehicles using titanium armor rather than steel armor. Since inception, this CoEE has received more than $1.8 million in federal and private research funding.

Automotive Systems Integration

Award Date: 2003 **Award Amount:** $5 million **Institution:** Clemson

BMW CoEE Endowed Chair in Automotive Systems Integration: Dr. Paul Venhovens

Systems integration is the testing of vehicle systems and their components to ensure efficient and safe operation. In order to serve this critical need, BMW committed itself as the major non-state partner for this CoEE Endowed Chair, which serves as the linchpin of the CU-ICAR faculty positions.

Dr. Venhovens' research concentrates on the following six areas: sustainable mobility; safer mobility; diagnostics and prognostics; vehicle architectures; concepts, methods and tools; and Deep Orange. The Deep Orange project allows CU-ICAR graduate students to create a vehicle from scratch over the course of two years. The pilot project produced a "GenY Cool" automobile, an extended range electric vehicle with a novel seating concept and open-architecture infotainment system designed specifically for the millennial market segment. Through 2010, the vehicle is being showcased at national and international auto industry-related conferences.

Automotive Design & Development

Award Date: 2003 **Award Amount:** $5 million **Institution:** Clemson

Timken CoEE Endowed Chair in Automotive Design and Development: Dr. John Ziegert

This CU-ICAR CoEE advances the fields of vehicular design and development, methodologies, and design tools. Dr. Ziegert and his team design automotive instruments and machines used in high-precision measurement and manufacturing. They also develop friction management and power transmission solutions that will improve manufacturing processes for a variety of industry sectors.

Non-state funding has been secured with the Timken Company. In September 2006, Timken opened its Greenville Technology Center on the CU-ICAR campus, which houses 200 employees and Timken's product development activities for automotive applications and its worldwide corporate center of excellence for dimensional and surface metrology and manufacturing process development. This CoEE also researches chassis fabrication for Dale Earnhardt, Inc. and X-5 assembly issues for BMW. This CoEE has received over $900,000 in federal and private grant funding.

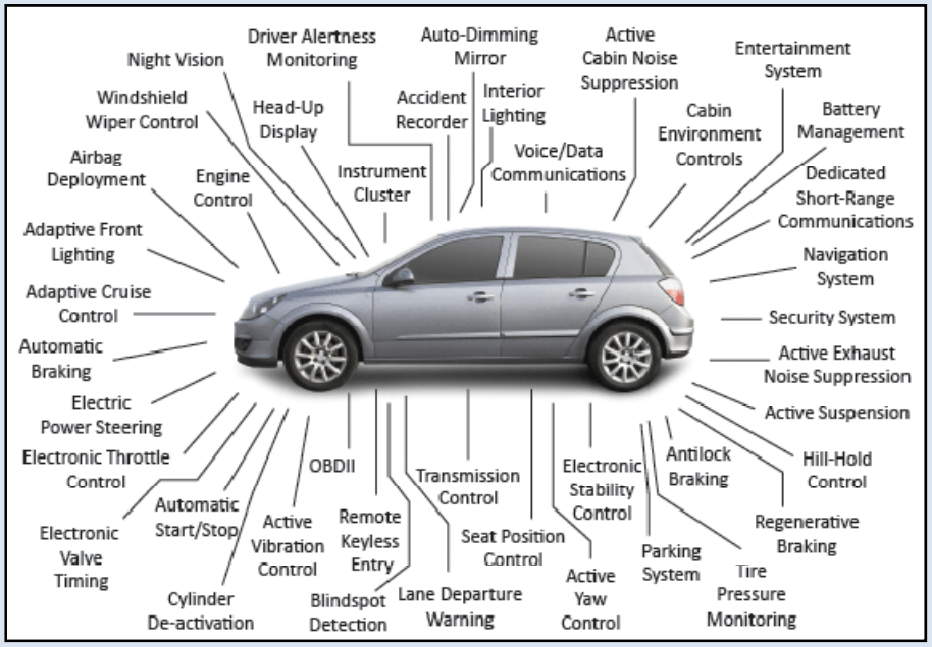
Vehicle Electronic Systems Integration

Award Date: 2004 **Award Amount:** $3 million **Institution:** Clemson

Michelin CoEE Endowed Chair in Vehicle Electronic Systems Integration: Dr. Todd Hubing

Dr. Hubing researches vehicle electronics, a complex field where components such as software, telematics, information systems, electronics, mechatronics, and sensors must be integrated in a well-balanced way to create attractive, stable products.

In FY2010, this CU-ICAR CoEE began a project with John Deere to develop a balancing network that will allow reduced costs of the electric motor drivers in lawnmowers. This partnership will continue as researchers will work to reduce the cost of high-voltage electric motor drivers used in hybrid vehicles.



Note: Today's automobile has dozens of computer-controlled electronic systems.

Supply Chain Optimization & Logistics

[not a CU-ICAR Automotive CoEE]

Award Date: 2005 **Award Amount:** $2 million **Institution:** Clemson

[Clemson hired Dr. Scott Mason as the FLUOR CHAIR IN SUPPLY CHAIN OPTIMIZATION & LOGISTICS in July 2010.]

This CoEE is a component of a larger initiative, the Clemson Institute for Supply Chain Optimization and Logistics (CISCOL). Research at this CoEE centers on supply chain modeling, material handling, logistics, planning systems and distribution.

Fluor Corporation is a full non-state partner for this CoEE. The CoEE has major ongoing projects with Michelin and Milliken. To date, the CoEE has received over $1.7 million in federal and private research funding. As of FY2010, more than 100 working professionals are enrolled in an online Capital Projects Supply Chain master's degree related to this CoEE. [See article on page 11.]

SOUTH CAROLINA CoEE

FUTURE FUELS™

UNIVERSITY OF SOUTH CAROLINA

6 CENTERS
7 COEE CHAIRS

Dr. Travis Knight, director of the USC Nuclear Engineering Graduate Program, performing research for the Nuclear Science & Energy CoEE.

Hydrogen Fuel Cells

Award Date: 2004 **Award Amount:** $5 million **Institution:** USC

Chairs: USC is recruiting a COEE CHAIR IN SENSORS FOR FUEL CELLS, AUTOMOTIVE & MEDICAL APPLICATIONS and a COEE CHAIR IN HYDROGEN STORAGE MATERIALS.

This CoEE conducts research to develop hydrogen storage materials and sensors for fuel cells. Fuel cells produce electricity from hydrogen and hydrogen-rich carbon fuels without thermal combustion and are more efficient for power generation than coal and natural gas technology. One startup company, Hydrogen Hybrid Mobility, has been created through associated work of this CoEE. To date, this CoEE has received over $5 million in private and federal research funding.

USC presently has the nation's only National Science Foundation Industry/University Cooperative Research Center (I/UCRC) for Fuel Cells, which was renewed in FY 2009 for five years.

Renewable Fuel Cells

Award Date: 2005 **Award Amount:** $3 million **Institution:** USC

Chair: USC is actively recruiting the COEE CHAIR IN RENEWABLE FUEL CELLS.

This CoEE is developing new catalysts that allow alternative fuels to be produced from renewable sources. These new catalysts are the "next wellhead" as the transportation sector moves to less dependence on imported oil and carbon fuel. To date, this CoEE has received over $1.8 million in research funding. Work associated with this CoEE has led to the creation of a startup company, Palmetto Fuel Cell Technologies.

Solid Oxide Fuel Cells

Award Date: 2006 **Award Amount:** $3 million **Institution:** USC

CoEE Endowed Chair in Solid Oxide Fuel Cell Research: Dr. Kenneth Reifsnider

Solid oxide fuel cells (SOFC) are one of two leading fuel cell types which are expected to find commercialized application in large, high-power systems such as full-scale industrial and large-scale electricity-generating stations. Applications for these fuel cells include large-scale power distribution for municipalities, rural areas and industries, as well as energy for homes. They could also provide mobile power for computers, cell phones and other electronics. Solid oxide fuel cells are highly efficient; operate with a number of fuels, including renewable fuels; and produce very low amounts of greenhouse gasses and pollution. This CoEE's goal is to remove barriers for the use of solid oxide fuel cells in society.

Currently, this CoEE has federal and private research funding totaling more than $10 million. Work associated with this COEE has led to the creation of a "cleantech" startup company, NextGenn, Inc.. The company is engaged in research and development in the areas of materials, mechanics, durability, systems, controls, fabrication and manufacturing of solid oxide fuel cells (SOFCs) and related technologies in order to develop and commercialize SOFC-based products.

Strategic Approaches to the Generation of Electricity

Award Date: 2007 **Award Amount:** $5 million **Institution:** USC

[USC hired Dr. Jochen Lauterbach as the COEE ENDOWED CHAIR in August 2010.]

The long-term research objective of the CoEE is to improve environmental control technologies for coal power plants, including the design of improved environmental control systems for mercury and acid gas emission control, as well as the development of new materials and processes for carbon sequestration and storage/ utilization. Santee Cooper and the Electric Cooperatives of South Carolina have provided the non-state matching funds for this CoEE. Two research projects for this CoEE have been initiated: one on the refining of crushed coal by particle size, and the second on pressure swing adsorption cycles for CO2 capture from coal-fired power plants.

Nuclear Science and Energy

Award Date: 2008 **Award Amount:** $3 million **Institution:** USC

Chair: USC is recruiting the COEE ENDOWED CHAIR IN ADVANCED MATERIALS AND NUCLEAR POWER.

This CoEE focuses on the design, development and analysis of advanced materials required to extend the life of existing nuclear power reactors and to develop a new generation of more efficient reactors. In FY 2010, this CoEE partnered with Savannah River National Laboratory (SRNL), Claflin University, U.C. Berkeley and AREVA, a global nuclear company. The CoEE received two grants totaling $2.7 million from the Department of Energy's Nuclear Energy University Program, which supports R&D activities at universities through competitive awards focused on advancing nuclear energy technologies.

Nuclear Science Strategies

Award Date: 2009 **Award Amount:** $3 million **Institution:** USC

Chair: USC is recruiting a COEE ENDOWED CHAIR IN ENERGY & NUCLEAR SECURITY.

This CoEE supports the thriving South Carolina nuclear energy industry. Specifically, this CoEE focuses on working with the nuclear industry and the Savannah River National Laboratory to create new engineering and technological innovations and methods of project management to reduce the cost of new nuclear plant construction, enhance the security of nuclear power generation, and address related social and policy issues. CoEE researchers will partner with other institutions including South Carolina State University and Clemson to educate the next generation of nuclear engineers and technicians. This CoEE received a grant from the U.S. Nuclear Regulatory Commission that will fund two USC Ph.D. students in nuclear science.

New nuclear plants are expected to result in $20 billion-plus in investment in SC over the next decade.

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RESEARCH • INNOVATION • INVESTMENT

NANOTECHNOLOGY

UNIVERSITY OF SOUTH CAROLINA

3 Centers
3 CoEE Chairs

USC CoEE Endowed Chair Dr. Richard Webb works wiring for his ultra-low temperature dilution refrigerator capable of cooling samples to 0.003 Kelvin (-459° F).

Nanostructures

Award Date: 2003 **Award Amount:** $4 million **Institution:** USC

CoEE Endowed Chair in Experimental Nanoscale Physics: Dr. Richard Webb

The Nanostructures CoEE concentrates on research in experimental nanoscale physics and is positioning the state to compete in the global future electronics market. CoEE Endowed Chair Dr. Richard Webb's scientific accomplishments include fabricating some of the world's smallest electronic circuits. He is one of only two USC researchers who are members of the National Academy of Sciences and is a fellow of the American Academy of Arts and Sciences.

This CoEE's research achievements include progress in understanding the "coherence in magnetic nanostructures" and the importance of "biological systems in potential electronic applications." To date, the CoEE has received over $4 million in research funding. In 2010, this CoEE formed a new collaboration with Hitachi Global Storage Technologies in California to study nanoscale devices that show promise for the magnetic recording industry. The company provides a wide range of products and services that store, preserve, and manage data to include advanced hard disk drives, enterprise-class solid state drives, and innovative external storage solutions and services.

Polymer Nanocomposites

Award Date: 2004 **Award Amount:** $3.5 million **Institution:** USC

CoEE Endowed Chair in Materials Science and Engineering: Dr. Brian Benicewicz

The South Carolina plastics industry accounts for nearly 5% of the Gross State Product of goods and services. As the plastics industry experiences commoditization of its basic materials (plastic polymers), this CoEE hopes to have a major impact on the state's manufacturing economy.

This CoEE is one of few national academic groups which has a complete system for making PET nanocomposites by in situ polymerization. CoEE Chair Dr. Brian Benicewicz and his research team have received over $3.2 million in research funding. This CoEE's work in high-temperature fuel cell membranes has resulted in a research contract with BASF. Work from this CoEE has also led to the creation of a startup company, Parallel Permeation, Inc. [See article on page 9.]

Nanoenvironmental Research & Risk Assessment

Award Date: 2008 **Award Amount:** $3 million **Institution:** USC

Chair: USC is recruiting the CoEE Endowed Chair for Nanoenvironmental Science.

Research at this CoEE focuses on the scientific, technological, health, economic, legal and societal effects of nanotechnology on the environment. As nanomaterials are small enough to cross cell membranes, they are potentially toxic to living organisms, including humans. There is growing demand for environmental health services in nanotech manufacturing and product assessment.

The initial area of research for this CoEE is nanoparticle environmental impact on estuarine sediments and organisms. The U.S. Environmental Protection Agency has awarded the CoEE research funding totaling over $375,000 to study the effect of single-walled carbon nanotubes on estuarine sediments and organisms.

Optical Materials

Award Date: 2004 **Award Amount:** $5 million **Institution:** Clemson

Chair: Clemson will recruit the J.E. SIRRINE TEXTILE FOUNDATION CHAIR IN OPTICAL FIBERS.

This CoEE is affiliated with Clemson's Center for Optical Materials Science and Engineering Technologies (COMSET) and has received major non-state funding from the J.E. Sirrine Textile Foundation. This CoEE focuses on the design, fabrication and testing of optical fibers for use in (a) directed energy systems critical to federal defense efforts, (b) communication systems for automobiles and information technologies, and (c) light-based biomedical therapies. The Optical Materials CoEE Endowed Chair will lead research in organic and inorganic materials for optical fiber and related photonic technologies.

The CoEE has launched two startup companies: Advanced Photonic Crystals and Tetramer Technologies. In April 2009, Gulf Fiber Optics relocated a subsidiary division, its research unit, and four employee positions to Anderson in order to be near the research work of this CoEE. In FY 2009, research partnerships were also formed with defense contractors Raytheon and Northrop Grunman. To date, the CoEE has received more than $13 million in federal and industrial research grants.

Advanced Fiber-Based Materials

Award Date: 2006 **Award Amount:** $4 million **Institution:** Clemson

Chair: Clemson will recruit the J.E. SIRRINE TEXTILE FOUNDATION ENDOWED CHAIR IN ADVANCED FIBER-BASED MATERIALS.

Research at this CoEE concentrates on the composition of novel fiber materials, fabrics and integrated components which possess unique functionality and value-added performance over traditional textile materials.

This CoEE is developing a niche industry in high-tech fibers and materials including fiber-reinforced composite materials based on metals, ceramics and polymers. CoEE research focused on capillary surface fibers applied in protein separation led to the 2007 creation of a startup company, Specialty Custom Fibers, located in Pendleton, SC. To date, this CoEE has garnered over $2.4 million in federal and private research grants.

Optoelectronics

Award Date: 2008 **Award Amount:** $2 million **Institution:** Clemson

Chair: Clemson is recruiting the PALMETTONET ENDOWED CHAIR IN OPTOELECTRONICS.

This CoEE focuses on improving devices, systems and protocols used in high-speed optical communication networks and is part of Clemson's Center for Optical Materials Science and Engineering Technologies (COMSET). This CoEE advances research in optoelectronics and optical communications theory and practice and seeks to meet the industry need for higher data rates and lower latency for switching and routing in optical networks.

SOUTH CAROLINA CoEE

SUSTAINABLE ENVIRONMENT

CLEMSON UNIVERSITY

2 Centers
2 CoEE Chairs

A Clemson CoEE researcher conducting work for the Intelligent River Project.

Urban Ecology & Restoration

Award Date: 2005 **Award Amount:** $2 million **Institution:** Clemson

Chair: Clemson will recruit the CoEE Endowed Chair in Urban Ecology and Restoration.

This CoEE supports the growth of the state's environmental industry and attracts world-renowned faculty in restoration development. This CoEE is unique for its interdisciplinary, integrative approach to the restoration of historic, ecological and urban infrastructure resources through the integration of basic science, engineering, and urban planning.

The CoEE was instrumental in Clemson's award of a 2008 Center of Excellence in Watershed Management by the U.S. Environmental Protection Agency. This is the third such center in the Southeast and the first in the nation focused on using remotely-sensed monitoring data. The CoEE, in conjunction with Clemson's Restoration Institute, sponsored the first annual S.C. Water Resources Conference in October 2008, which was attended by over 350 participants. The CoEE has initiated four multidisciplinary urban ecology projects in the state. To date, this CoEE has received more than $1.7 million in federal and private research grant funding.

Sustainable Development

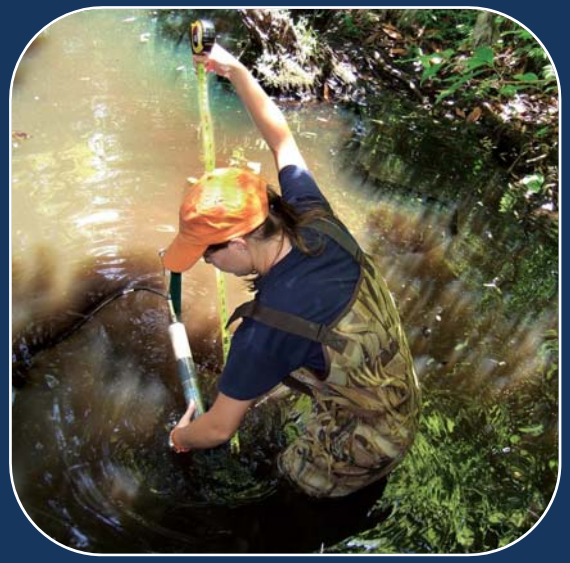
Award Date: 2010 **Amount:** $4 million

Institution: Clemson

Chair: Clemson will recruit the Thomas F. Hash '69 Chair in Sustainable Development.

This CoEE's mission is to advance sustainable development through technological innovation. This includes the development of new technologies, from optically-based chemical sensors to wireless networking platforms, as well as the development of new environmental and ecological models designed to support real-time monitoring and management of natural and built environments.

The CoEE will build on the success of the Intelligent River Project, which focuses on the development of hardware, software and modeling infrastructure to support real-time management of water resources across the state. More than 75 Clemson faculty members and students in areas such as wetland ecology, hydrology, landscape architecture, computer sciences, computer engineering, and environmental toxicology are working together on this project.



Biosystems engineering students monitor water quality in Georgetown County near Clemson's Baruch Institute for Coastal Ecology and Forest Science.

Cyber-Institute

Award Date: 2008 **Award Amount:** $2 million **Institution:** Clemson

Chair: Clemson will recruit the C. TYCHO HOWLE ENDOWED CHAIR IN COLLABORATIVE COMPUTING ENVIRONMENTS.

This CoEE concentrates its research on developing, testing and evaluating prototype cyberinfrastructure (CI) equipment and programs, leading to stronger collaborative environments for research, education and technology transfer throughout South Carolina. Objectives for this CoEE include increasing the level of research funding to build integrated CI in the state; connecting research and scholarship in the field to the commercial sector through corporate partnerships; expanding the creation and utilization of CI resources in South Carolina; and developing an education and workforce development program.

Data Analysis, Simulation, Imaging, and Visualization

Award Date: 2010 **Award Amount:** $2 million **Institution:** USC

Chair: USC will recruit a COEE ENDOWED CHAIR IN DATA ANALYSIS, SIMULATION, IMAGING, AND VISUALIZATION

This CoEE's objective is to develop cutting-edge science and technology for transforming data into knowledge by extracting information and its faithful representation and visualization. The Center focuses on specific high priority areas including in-line data processing, multi-sensor data acquisition, tissue modeling, atomic scale imaging, and bioimaging. The Center aims to create relationships between academia and industry to attract talent and knowledge-based businesses to the state.

Tourism & Economic Development

Award Date: 2005 **Award Amount:** $2 million
Institutions: USC/Coastal Carolina University
CoEE Endowed Chair in Tourism and Economic Development: Dr. Simon Hudson

Tourism is the number one industry in South Carolina, responsible for more than $17 billion dollars in spending and employing more than 200,000 people—approximately 10 percent of South Carolina's workforce. This CoEE's mission is "to lead cutting-edge tourism and hospitality research that is relevant and directly applicable to the South Carolina tourism industry. This ultimately will improve South Carolina's competitiveness as a tourism destination, thus securing sustainable employment in the tourism sector. The CoEE will take a novel, applied approach linking tourism to the other industrial sectors within the state and will provide models for cities, state, regions, and nations attempting to use tourism as a catalyst for economic development. [See article on page 15.]

Neuroscience

5 Centers / 15 CoEE Chairs

Brain Imaging CoEE researcher Dr. Michael Schillaci assists a patient in the Siemens Magnetom Trio Magnetic Resonance Imaging System at USC.

Brain Imaging

Award Date: 2003 **Award Amount:** $5 million **Institutions:** USC/MUSC

USC Chair: USC is in final negotiations for the CoEE Chair in Cognitive Neuroimaging.
[MUSC hired Dr. Joseph Helpern as one of two CoEE Endowed Chairs in September 2010.]

MUSC Chair II: MUSC is recruiting a second CoEE Endowed Chair in Brain Imaging.

This collaborative CoEE is creating a world-class brain imaging center and is likely to spawn startup companies in the areas of deception detection (lie detection) and minimally invasive brain stimulation technologies. Funding to date is $15 million.

A CoEE partnership has been formed with Ladson-based Force Protection Industries (FPI). A leading manufacturer of tanks and armored vehicles, FPI will use CoEE research in the prevention of traumatic brain injury due to combat explosions. FPI will use this research to develop better explosive-resistant military vehicles, while the CoEE will use the findings to better detect and treat traumatic brain injury.

Neuroscience

Award Date: 2003 **Award Amount:** $3 million **Institution:** MUSC

William H. Murray CoEE Endowed Chair in Neuropathology: Dr. Gary Aston-Jones

Chairs: MUSC is recruiting the CoEE Endowed Chair in Movement Disorders and the Josephine Tucker Morse Endowed Chair in Parkinson's Disease Research.

This CoEE researches age-related neurodegenerative problems including dementia, Alzheimer's, Parkinson's and stroke. This area of research has a major impact on South Carolina, where over half the population is over the age of 56.

The CoEE has supported the creation of SemiAlloGen, Inc., a biotechnology startup company. This CoEE is developing a project with Jazz Pharmaceuticals to test mechanisms of action of the drug Xyrem. The CoEE has partnered with Cephalon Pharmaceuticals and Lilly Pharmaceuticals to test brain reward function. It has also begun discussions with Pfizer and GlaxoSmithKline to test two antagonists as potential treatment of addiction.

The CoEE has received over $9 million in research funding. In FY 2010, Chair Aston-Jones' research of the brain nucleus locus coeruleus spurred an article on the causes of autism by the director of the Simons Foundation Autism Research Initiative.

Vision Science

Award Date: 2005 **Award Amount:** $4.5 million **Institutions:** MUSC/USC

MUSC Chairs: MUSC is recruiting a CoEE Endowed Chair in Gene and Pharmaceutical Treatment of Retinal Degenerative Disease and a CoEE Endowed Chair in Bioengineering and Material Science Techniques.

USC Chair: USC is recruiting a CoEE Endowed Chair in Gene and Pharmaceutical Treatment of Retinal Degenerative Disease.

This CoEE focuses on gene and pharmaceutical treatments of macular degeneration, glaucoma, retinitis pigmentosa and other eye diseases. Partners include Alcon Labs, Alimera Scientific, Inotek Pharmaceutics, QLT Inc., Taligen Inc., and Pfizer. To date, over $2.3 million in research funds have been received for this CoEE.

Childhood Neurotherapeutics

Award Date: 2006 **Award Amount:** $5 million **Institutions:** USC/MUSC
USC Chairs: USC is recruiting Chairs in CHILD & ADOLESCENT NEUROCHEMISTRY and TRANSLATIONAL THERAPEUTICS.
MUSC Chair: MUSC is actively recruiting the COEE ENDOWED CHAIR IN NEURODEVELOPMENTAL DYSFUNCTION IMAGING.

Research at this CoEE focuses on the prevention of brain damage in premature infants and curing infant brain diseases through cellular engineering. In collaboration with the Greenville Hospital System, this CoEE operates a statewide team that is developing neural stem cell therapeutic approaches to neurological disorders in children. This important discovery will allow the CoEE to impact the treatment of these disorders and transfer research knowledge directly to patient application. This CoEE shares a FDA grant with the Philadelphia Children's Hospital to evaluate the efficacy of atorvastatin for Type I diabetes patients. These studies have resulted in a startup company, ImmunoMod, which develops drugs for treatment of diabetes. To date, faculty associated with this CoEE have generated over $3.3 million in research funding.

Drs. Marc Chimowitz (l) and Robert Adams (r), CoEE Endowed Chair stroke experts, examine brain scans using telemedicine methods.

Stroke

Award Date: **2007** Award Amount: **$5 million**
Institutions: MUSC/USC
CoEE Endowed Chair in Stroke: Dr. Robert Adams (MUSC)
Countess Alicia Paolozzi Chair in Translational Neurology: Dr. Marc Chimowitz (MUSC)
CoEE Chair in Clinical Neurology: Dr. Souvik Sen (USC)

The reduction in the incidence of stroke and the provision of acute stroke care are goals of this CoEE. This collaborative effort enhances the research programs of MUSC, USC, Greenville Health Systems and the Greenwood Genetics Center and strengthens clinical and basic stroke research in South Carolina. With three CoEE Chair positions, this CoEE will increase translational stroke research and stimulate the development of new therapeutics, drug discovery and biotechnology.

In May 2008, this CoEE implemented the REACH Network, which provides around-the-clock, Internet-based stroke consultation for patients within the first three hours of a stroke occurrence. Both MUSC and USC serve as hubs for this network, with "virtual spokes" reaching out to nine community hospitals throughout the state, with other hospitals considering connection. Doctors at MUSC treat stroke victims at community hospitals remotely with t-PA (Tissue Plasminogen Activator) thrombolytic therapy through telemedicine. To date, the REACH Network has performed 125 t-PA telemedicine treatments.

Health Care

5 Centers / 11 CoEE Chairs

USC CoEE Endowed Chair Dr. Sue Levkoff of the SeniorSMART™ Center with Mr. Charlton Hall, whose private donation provided a significant portion of this CoEE's non-state match.

Clinical Effectiveness and Patient Safety

Award Date: 2006 **Award Amount:** $5 million **Institutions:** MUSC/USC

Lewis Blackman CoEE Endowed Chair for Patient Simulation and Research for Health Sciences South Carolina: Dr. John Schaefer (MUSC)

CoEE Endowed Chair in Biomedical Informatics: Dr. Jihad S. Obeid (MUSC)

College of Nursing CoEE Endowed Chair for Health Informatics Quality and Safety Evaluation: Dr. Rita Snyder (USC)

With five operational Simulation Centers across the state, this CoEE improves clinical education and patient safety through the use of simulation technology. Its goals include improving the quality of delivered care, advancing the practice and training of the medical workforce from student nurses to practicing physicians, and becoming an international focal point for health sciences education and innovative research in education and safety.

Since 2008, more than 14,000 students have participated in CoEE Simulation Center classes. A startup company, Sim Tunes, LLC, has been created to facilitate and has entered into a contract with Laerdal Medical to sublicense programmed clinical scenarios used in simulation classes. [See article on page 7.]

Health Facilities Design & Testing

Award Date: 2007
Award Amount: $5 million
Institutions: Clemson/MUSC
Clemson Chair:
Clemson will recruit the CoEE Chair in Architecture & Health Research.
MUSC Chair:
MUSC is recruiting the CoEE Endowed Chair in Human Factors Medical Research.

Patient prototype room for the Health Facilities Design & Testing CoEE.

The purpose of the CoEE is to expand and disseminate knowledge on how health facility design impacts health and healthcare delivery and how to create architectural settings that better support the health and well-being of patients and staff. Through interdisciplinary research, this CoEE addresses the relationship between physical healthcare environments and the following four areas: health and clinical outcomes; patient, family and staff satisfaction; operational efficiencies; and the ability to accommodate change.

In FY2010, researchers continued work on a Department of Defense subcontract entitled "Patient Room of the Future." A physical prototype room was completed in July 2008; analysis continues on the impact of nature views on health, headwall design performance, and lighting design concepts.

Health Care Quality

Award Date: 2007 **Award Amount:** $5 million **Institutions:** USC/MUSC/Clemson
CoEE Endowed Chair in Medical Bioinformatics: Dr. Iain Sanderson (MUSC)
CoEE Endowed Chair in Translational Clinical Research: Dr. Jay Moskowitz (USC)

This CoEE conducts research on the state's major health problems, with the goal of improving the health of South Carolinians and the state's economy. The CoEE has partnered with the S.C. Hospital Association for multiple benefits, including supporting statewide initiatives and translating new products and processes to hospitals. In February 2009, the S.C. Healthcare Quality Trust was launched as a partnership between this CoEE, HSSC, the S.C. Hospital Association, and Premier, Inc., with the goal of reducing healthcare-associated infections. According to Premier, Inc., infection reduction could save state hospitals up to $40 million a year and reduce patient stays by 24,000 days. As causes are determined and preventive measures tested, results will be shared with all 65 acute-care hospitals in South Carolina.

USC CoEE Endowed Chair and Health Sciences South Carolina President Dr. Jay Moskowitz:

"In FY2010, the Health Care Quality CoEE received federal awards in excess of $10 million, which will help place South Carolina squarely on the biomedical industry map. This CoEE is building the nation's premier health records exchange systems [SC Health Data Portal] as well as a statewide clinical trial program which will allow national and South Carolina companies to conduct the complex, regulated research required to develop new biomedical devices and medicines."

SeniorSMART™ Center

Date: 2007 **Amount:** $5 million **Institutions:** USC/Clemson
CoEE Chair in Community & Social Support: Dr. Sue Levkoff (USC)
USC Chair II: CoEE Chair for Memory and Brain Function.
Clemson Chair: Driving, Mobility & Physical Functioning.

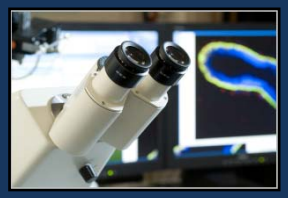
This CoEE focuses on research to foster independence for seniors via three components: SMARTBrain™ (maintaining intellectual activity); SMARTWheels™ (promoting independent mobility outside the home); and SMARTHome™ (maintaining independent mobility inside the home). In FY2010, the newly opened Duke Endowment-funded Palmetto Health-USC Mobility and Research Clinic opened and is now evaluating and treating patients and has initiated collection of research data.

Medication Safety and Efficacy

Date: 2008 **Amount:** $2 million **Institutions:** MUSC/USC
CoEE Chair in Medication Safety & Efficacy: Dr. Charles Bennett

This CoEE focuses on increasing drug safety and effectiveness, as well as decreasing medication errors by identifying the incidence and significance of adverse drug events. This data will be provided to hospitals, pharmaceutical and insurance companies, and governmental agencies (such as Medicaid and Medicare) for use in epidemiological and economic studies and will help lead to fewer drug injuries and improved drug effectiveness.

BIOTECHNOLOGY



10 CENTERS / 21 COEE CHAIRS

MUSC Marine Genomics CoEE Endowed Chair Dr. Louis Guillette engaged in a project with NASA to examine potential health effects of contaminants: "We study the alligator as a sentinel species for ecosystem health and to give us warning if there is potential danger to humans working in the area."

Marine Genomics

Award Date: 2003 **Award Amount:** $4 million **Institutions:** MUSC/USC/Coll. of Charleston
CoEE Endowed Chair in Marine Genomics: Dr. Louis J. Guillette (MUSC)
CoEE Endowed Chair in Marine Genomics: Dr. Stephen Kresovich (USC)
[MUSC has announced the 2011 appointment of Dr. Gavin Naylor as the Bioinformatics Chair.]

The Marine Genomics CoEE researches marine functional genomics and bioinformatics, which include the analysis of physiological adjustments in animal and plant genetics that result from environmental changes. Investors and collaborators for this CoEE include Hollings Marine Laboratory (HML), the National Oceanic and Atmospheric Administration, and the S.C. Department of Natural Resources. To date, the CoEE has partnered with two private companies, Shrimp Improvement Systems and Biogenmar, and is negotiating a formal relationship with a third company, Martek, to test the antiviral effect of algae incorporated in shrimp diets. Since inception, the CoEE has received over $6 million in federal and state grant funding.

Proteomics

Award Date: 2003 **Award Amount:** $4 million **Institution:** MUSC
Chair: MUSC is actively recruiting two COEE ENDOWED CHAIRS IN PROTEOMICS.

The Proteomics CoEE pursues research in technologies that study information encoded in the genomes of proteins. The field of proteomics research is expected to lead to an understanding of cellular function at the molecular level, particularly in disease. This CoEE has received over $12 million in research grants. This includes NIH funding for one of only ten U.S. National Heart, Lung and Blood Institute Proteomics Centers. This CoEE continues its partnership with the U.S. Department of Energy Molecular Foundry to develop a new type of microfluidic valve based on a nanostructured polymer for use in proteomic analysis devices.

Molecular Proteomics in Cardiovascular Disease and Prevention

Award Date: 2006 **Award Amount:** $5 million **Institution:** MUSC
Chairs: MUSC is actively recruiting the TOURVILLE COEE ENDOWED CHAIR IN CARDIOVASCULAR IMAGING FOR DIAGNOSIS AND PREVENTION and the VOLPE COEE ENDOWED CHAIR IN CARDIOVASCULAR BIOMARKER DEVELOPMENT FOR DIAGNOSIS AND PREVENTION.

This CoEE advances cardiovascular (CV) prevention and treatment "bench" science into clinical "bedside" care. The CoEE continues a statewide network of five primary, separate care locations to participate and be linked by a central bioinformatics core. This core allows patients who suffer or are at risk for CV disease across the state to be screened. In FY 2009, plasma screening was conducted for 450 patients. Through this screening, 16 plasma proteins were analyzed and a specific biomarker portfolio was created for the diagnosis and prediction of left ventricular hypertrophy and diastolic heart failure.

Regenerative Medicine

Award Date: 2004 **Award Amount:** $5 million **Institutions:** MUSC/USC/Clemson
CoEE Endowed Chair in Regenerative Medicine: Dr. Richard Swaja (MUSC)
BlueCross BlueShield of SC Foundation CoEE Chair in CV Health: Dr. Martin Morad (USC)
[Clemson hired Dr. Xuejen Wen as the HANSJÖRG WYSS CHAIR OF BIOENGINEERING in August 2010.]

Regenerative medicine is the regeneration of tissue and organs for the purpose of repairing, replacing and maintaining organ function. This CoEE combines statewide expertise in developmental biology, adult stem cell technology and tissue engineering. The most significant scientific accomplishments thus far are in the field of bioprinting, the assembly of living 3D human tissues and organs using rapid prototyping technology. In addition, advances in the multiple areas of bioengineering, wound healing, vascular biology, orthopedic materials science and cardiac development have led to an effort to construct a biofabricated blood vessel network. To date, the CoEE has received over $32 million in research funding. This CoEE will also play a major role in the $20 million statewide NSF grant awarded in July 2009 for tissue and organ biofabrication. Two research contract partnerships were developed this past year with Synthes USA. A startup company, FirstString, was created in 2006, which features new wound repair technology; FirstString has generated revenue in excess of $1.2 million.

Rehabilitation and Reconstruction Sciences

Award Date: 2007 **Award Amount:** $5 million **Institution:** USC
Chair: USC will recruit a COEE ENDOWED CHAIR IN RECONSTRUCTIVE METHODOLOGIES AND MATERIALS.

The CoEE in Rehabilitation and Reconstruction Sciences is focused on medical and public health needs in the area of orthopedic disorders, exercise and sports-related injury prevention, treatment and rehabilitation. Collaboration among the four intellectual cores, Cellular Engineering; Rehabilitation and Performance Sciences; Epidemiology and Clinical Translation; and Education, help translate basic science to bedside care. The CoEE investigates the biologics of tissue-engineered materials and implantable devices to find solutions to a variety of musculoskeletal maladies. Partners include the Biologics & Spine division of global medical device company Smith & Nephew, which has announced a $5 million match for this Center.

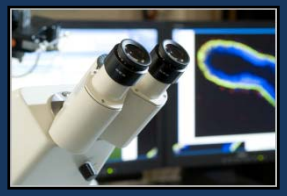
Renal Disease Biomarkers

Award Date: 2008 **Award Amount:** $5 million **Institution:** MUSC
Chairs: MUSC is recruiting a COEE CHAIR IN RENAL BIOMARKERS and a CHAIR IN TRANSLATIONAL NEPHROLOGY RESEARCH.

This CoEE addresses the need for reliable and prognostic biomarkers and biological indicators for acute kidney injury and chronic renal (kidney) failure. Accurate and sensitive biomarkers are essential for early disease detection and treatment. This area of research is especially relevant in South Carolina: diabetes is the leading cause of kidney failure, and South Carolina has a two percent higher rate of diabetes than the U.S. average.

CoEE faculty continue to partner with the Southern Acute Kidney Injury Network (SAKInet), which includes researchers from Duke University, George Washington University, the University of Tennessee system, and the MD Anderson Cancer Center (TX) in order to facilitate biomarker discovery. Investigators have published a manuscript which identifies a set of proteins in urine that can distinguish between two common acute kidney diseases, which are difficult to diagnose clinically; this discovery may lead to developing a crucial clinical test. To date, this CoEE has received over $1.7 million in research funding.

BIOTECHNOLOGY CONT'D.



Advanced Tissue Biofabrication

Award Date: 2008 **Award Amount:** $5 million **Institutions:** MUSC/USC/Clemson
MUSC Chair: MUSC is recruiting a CoEE Endowed Chair in Biofabrication Biology.
USC Chair: USC is recruiting a CoEE Endowed Chair in Biofabrication Engineering.
Clemson: Clemson will recruit a CoEE Endowed Chair in Biofabrication Engineering.

The vision for this CoEE involves industrial-scale production of complex tissues and organs for the repair, replacement or restoration of diseased cells, tissues and organs. Researchers will focus on "bioprinting," assembling human tissues and organs by layering living cells and a hydrogel.

This CoEE plays a major role in the 2009 statewide $20 million NSF grant. Along with MUSC, nine other South Carolina institutions participate in this project: Clemson, USC, Claflin University, S.C. State University, Voorhees College, Furman University, USC-Beaufort, Denmark Technical College, and Greenville Technical College. According to Dr. Roger Markwold of MUSC, lead scientist on the grant, the project's mission is building "tissue and organs from the inside out, which is a different approach than anyone has taken. First, we want to create a three-dimensional vascular tree and then the organ. This will allow the development of applications to build many different types of organs."

Tissue Systems Characterization

Award Date: 2009 **Award Amount:** $3 million **Institution:** Clemson
Chair: Clemson will recruit the CoEE Chair in Tissue Systems Characterization.

Part of a larger Clemson initiative, the Institute for Biological Interfaces of Engineering (IBIOE), this CoEE expands on Clemson's expertise in tissue engineering and biomaterials to provide alternatives to animal testing. This CoEE also allows Clemson researchers to further explore new tissue-based technologies that could serve as diagnostic or therapeutic products. The CoEE Endowed Chair will lead the cell biology component of IBIOE, creating a strategic research program for the analysis of cell mechanisms and behaviors, resulting in 3D tissue systems.

Healthful Lifestyles

Approval Date: June 2009 **Award Amount:** $3 million Institutions: USC/MUSC
USC Chair: USC is recruiting a CoEE Endowed Chair in Technology Application for Health Behaviors Change.
[MUSC hired Dr. Frank Treiber as the CoEE Endowed Chair of Technology Applications for Health Behavior Change in August 2010.]

This CoEE focuses on health problems caused by physical inactivity, poor diets, and other poor health behaviors to develop and test lifestyle interventions for improving health, preventing illness, and managing chronic health problems. Successful components will be translated into cost-effective programs and new products that will be marketed in clinical care, public health, worksites, and other community settings.

Inflammation & Fibrosis Research

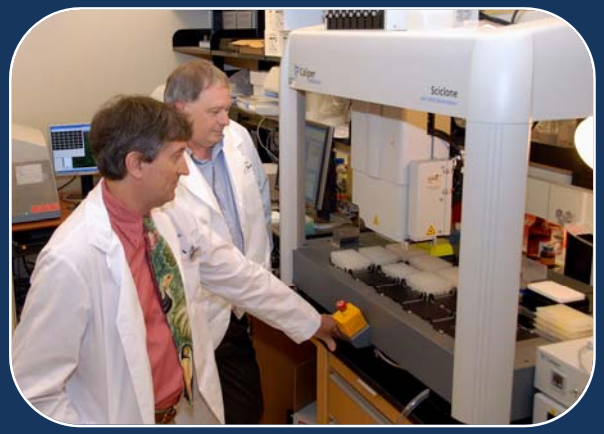
Award Date: 2010 **Award Amount:** $5 million **Institution:** MUSC
Chairs: MUSC was awarded a CoEE Chair in Inflammation Research and a Kitty Trask Holt CoEE Chair for Scleroderma Research.

The CoEE will address the need for novel anti-inflammatory and anti-fibrotic drug therapies by supporting a program that aligns clinical and basic science investigators with the common goal of developing effective treatment for inflammatory and fibrosing diseases. The COEE will support two endowed chairs, one focusing on inflammation and another focusing on fibrosis, each with the common goal of developing safe and effective therapies to be brought to commercial fulfillment. Inflammation and fibrosis are fundamental aspects of disease exemplified by two connective tissue diseases (CTD), lupus and scleroderma, each having pathobiologic pathways relevant to other diseases.

CANCER

[SEE ARTICLE ON PAGE 19.]

7 CENTERS / 17 COEE CHAIRS



CoEE Endowed Chair Kenneth Tew (l) of the Translational Cancer Therapeutics CoEE and CoEE Endowed Chair Charles Smith (r) of the Cancer Drug Discovery CoEE inspect a liquid-handling high throughput robot component in the Drug Discovery Core at MUSC.

Translational Cancer Therapeutics

Award Date: 2004 **Amount:** $5 million **Institutions:** MUSC/USC
John C. West Chair in Cancer Research: Dr. Kenneth Tew (MUSC)
USC Chair: USC is finalizing the search for the CHAIR IN DRUG EFFICACY.

CoEE Chair Dr. Tew has an international reputation as a cancer drug researcher and developer. His research was pivotal in the design of treatment for hormone refractory prostate cancer. Tew's research has also proven instrumental in the late-stage clinical testing of two promising drugs for ovarian and lung cancer and another that serves as a modifier of bone marrow-mediated immune function. Tew is conducting research on how cancer cells develop resistance to different drugs. Discoveries from his work have suggested links between cancer and Alzheimer's. In 2010, Tew received the ASPET-Astellas Award for Translational Pharmacology, which recognizes pharmacological research accomplishments that seek to extend fundamental research closer to applications directed toward improving human health. Research funding for this CoEE totals more than $5 million.

Cancer Drug Discovery

Award Date: 2005 **Amount:** $5 million **Institutions:** MUSC/USC
Charles & Carol Cooper Chair in Pharmacy: Dr. Charles Smith (MUSC)
GlaxoSmithKline Distinguished Endowed Chair: Dr. John Lemasters (MUSC)
Additional Chairs: MUSC is recruiting a CoEE Chair in Medicinal Chemistry and a CoEE Endowed Chair in Structural Biology.

This CoEE provides mechanisms for target identification and generation of lead compounds in the drug discovery process, creating a productive interface (lacking in the field) between academics and biotechnology/pharmaceutical industries. This CoEE also develops research in structural biology for designing drug candidates and biomed screening technology.

Using a drug screening core with chemical libraries of 50,000 compounds, CoEE Chair Dr. Charles Smith and another colleague identified compounds which inhibit PIM kinase enzymes which are over-expressed in cancer. Dr. Smith launched Vortex Biotechnology Corp. in 2009 to create marketable PIM protein kinase inhibitors to treat cancer. In 2009, another startup company, SchnellGen, developed out of the work of this CoEE. Its mission is to develop novel therapeutics for the treatment of acute organ failure and wound healing. In FY 2010, a third startup company arose, MitoHealth. The CoEE has received nearly $10 million in research funding.

Cancer cont'd.

GI Cancer Diagnostics

Award Date: 2005 **Award Amount:** $5 million **Institution:** MUSC
Grace E. DeWolff Chair in Medical Oncology: Dr. Melanie B. Thomas
Additional Chair: MUSC is recruiting a CoEE Endowed Chair in GI Malignancy Diagnostic & Therapeutic Trials.

This CoEE researches translational medicine for gastrointestinal (GI) cancer patients in order to decrease cancer mortality and morbidity. Areas of research include molecular profiling, therapeutic targets, screening technologies, therapy and population studies, with particular emphasis on esophageal cancer, which is prevalent in South Carolina.

Partners for this CoEE include Roche Carolina and Bank of America. This CoEE has received over $6 million in research funding. CoEE faculty are conducting clinical trials in pancreatic, colon, kidney, liver and esophageal cancers. CoEE Chair Dr. Melanie Thomas is collaborating on a clinical trial with Cancer Drug Discovery CoEE Chair Dr. Charles Smith to test the success of a new drug for pancreatic cancer developed in Dr. Smith's CoEE laboratory. In FY 2010, Dr. Thomas organized the first GI Cancer Research Retreat in order to chart a unified vision for the growth of GI cancer research. As an outcome of the retreat, two NIH grant submissions were created. [See additional information on page 14.]

Tobacco-Related Malignancies

Award Date: 2007 **Award Amount:** $5 million **Institution:** MUSC
Chair: MUSC is recruiting the BMW Endowed Chair in Cancer Research.
[MUSC hired Dr. George Simon as The Burtschy Family Chair in Cancer Research in July 2010.]

This CoEE is devoted to discovering tobacco-related malignancy biomarkers. The initial focus is lung cancer, but Center leaders also hope to make advances in other tobacco-related malignancies including head and neck, bladder and esophageal cancers.

In 2008, this CoEE and the Hollings Cancer Center (HCC), formed an alliance with the University of Colorado Comprehensive Cancer Center on the renewal of an NCI-funded Specialized Center of Research Excellence (SPORE) in Lung Cancer. Two CoEE researchers, Drs. Gemmill and Drabkin, have clinical trials partnerships with Syndax, Pfizer and Novartis. As a result of the National Cancer Institute designation for HCC, a new collaborative project, NAVIGATE, has been initiated between HCC, Spartanburg Regional Healthcare System, and St. Joseph's/Candler Hospital in Savannah, in order to elucidate specific barriers experienced by thoracic and esophageal cancer patients when seeking timely treatment options. The CoEE has received over $12 million in research funding.

Cancer Disparities

Award Date: 2008 **Award Amount:** $3.6 million **Institutions:** MUSC/USC/South Carolina State University
MUSC Chairs: MUSC is actively recruiting two CoEE Endowed Chairs in Cancer Disparities.
USC Chair: USC is actively recruiting a CoEE Endowed Chair in Cancer Disparities.

This CoEE will increase prostate cancer screening and early detection among African-American men. Despite the fact that prostate cancer mortality rates in South Carolina are three times greater for African-Americans than for Caucasians, African-Americans are significantly underrepresented in prostate cancer clinical trials. A common barrier to the development of new knowledge for medical problems affecting racially and ethnically diverse populations is the ability to enroll diverse patients in medical research. The CoEE Chairs will conduct prostate cancer clinical trials and examine aspects of obesity and lifestyle modifications as contributing factors to prostate cancer. They will also examine factors that influence the screening and treatment of African-American men. The AT&T Foundation provided a $1 million gift to MUSC to provide free prostate cancer screenings and treatment advice and education to 500 African-Americans in South Carolina.

Cancer Stem Cell Biology & Therapy

Award Date: 2008 **Award Amount:** $5 million **Institutions:** MUSC/Clemson
Chairs: MUSC is recruiting a COEE ENDOWED CHAIR IN BIOMEDICAL ENGINEERING.
[MUSC hired Dr. Zihai Li as the COEE ENDOWED CHAIR IN CANCER STEM CELL BIOLOGY in July 2010.]

This CoEE focuses on developing new technologies for isolating, growing and manipulating cancer stem cells. Cancer stem cells are adult stem cells that have the ability to reproduce themselves and develop into cancer cells. The CoEE will find ways to use adult stem cells from bone marrow or organs to treat cancer. The work of this CoEE will generate further understanding of cancer stem cells and ways to eradicate them without harming healthy cells. Research could also lead to the engineering of healthy adult stem cells that can replace cancerous cells in the body.

This CoEE will seek to add a repository of adult cancer stem cells to the Health Sciences South Carolina tissue repository for use in further research across South Carolina. To date, the CoEE has received over $4 million in extramural research funding. CoEE senior researcher Dr. Bryan Toole is studying the use of hyaluronan, a compound which resides on the surface of cancer stem-like cells, as a treatment for glioblastoma tumors. Hyaluronan, along with two other substances, regulate the activities of cancer stem-like cells.

Dr. Luciano Costa, an MUSC researcher for the Cancer Stem Cell Biology & Therapy CoEE, reviews CT (computed tomography) scan results with a stem cell transplant recipient.

Lipidomics, Pathobiology & Therapy

Award Date: 2009 **Amount:** $5 million **Institution:** MUSC
Chairs: MUSC is recruiting a COEE ENDOWED CHAIR IN LIPIDOMICS AND PATHOBIOLOGY and a COEE ENDOWED CHAIR IN LIPIDOMICS DRUG DISCOVERY.

This CoEE will translate basic lipidomics research into an understanding of how lipids play a role in health problems such as cancer, inflammation, and diabetes. Researchers will identify new targets for diagnostics or treatments. Since inception, this CoEE has garnered over $6 million in extramural research funding.

(l to r) MUSC President Raymond Greenberg, USC President Harris Pastides, and Clemson President James Barker serve as ex-officio, non-voting members of the CoEE Review Board.












S.C. Centers of Economic Excellence Review Board

Top Row: Pamela P. Lackey (Chair), Regan Voit (Vice Chair), Bobby Pearce (Secretary).
Second Row: Melvin Williams, Patricia Wilson, Keith Munson.
Third Row: Bobby Hitt, J. Lyles Glenn, Michael Couick.

The CoEE Council of Chairs

Top Row: Clemson University CoEE Endowed Chairs Todd Hubing, Tom Kurfess (FY 2010 Council Chair-Elect), Scott Mason, Paul Venhovens, Xuejen Wen, John Ziegert.

Second Row: USC CoEE Endowed Chairs Brian Benicewicz, Charles Bennett, Simon Hudson, Steve Kresovich, Jochen Lauterbach, Sue Levkoff, Martin Morad, Jay Moskowitz, Kenneth Reifsnider, Souvik Sen, Rita Snyder, Richard Webb.

Third Row: MUSC CoEE Endowed Chairs Robert Adams, Gary Aston-Jones, Marc Chimowitz, Louis Guillette, Mark Helpern, John Lemasters, Zihai Li, Jihad Obeid, Iain Sanderson.

Fourth Row: MUSC CoEE Endowed Chairs John Schaefer, George Simon, Charles Smith, Richard Swaja (FY 2010 Council Chair), Kenneth Tew, Melanie Thomas, Frank Treiber.

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Official CoEE Program Website:
WWW.SCCOEE.ORG

CoEE Review Board Meeting Materials available at:
WWW.ENDOWEDCHAIRS.ORG

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CoEE Program Mission Statement

The S.C. Centers of Economic Excellence Program serves the public interest by creating incentives for the state's research universities, in cooperation with other institutions of higher education in the state, to raise capital from non-state sources to fund endowments for specialized research professorships. These professorships in turn serve as the nucleus for unique, university-based research centers which cultivate critical, public-private industrial partnerships, expand the state's knowledge base, create well-paying jobs, and enhance economic opportunities and improve the quality of life for the people of South Carolina.

The *South Carolina Centers of Economic Excellence Annual Report to the South Carolina General Assembly and the South Carolina Budget & Control Board Report* is published annually by the South Carolina Centers of Economic Excellence Review Board and the South Carolina Commission on Higher Education in accordance with S.C. 2-75-10.

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MUSC CoEE Endowed Chair Dr. Gary Aston-Jones of the Neuroscience CoEE.